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**HYDROLOGIC & HYDRAULIC REPORT
“The Village At Institute Road”
In
Grafton Main, Massachusetts**

September 13, 2016

Prepared for:

D&F Afonso Builders, Inc.
189 Main Street
Milford MA 01757

Prepared by:

Guerriere & Halnon Inc
333 West Street
Milford, MA 01757

HYDROLOGIC & HYDRAULIC REPORT
"The Village At Institute Road", Grafton Ma

SITE LOCATION & DESCRIPTION

The site is located off of Institute Road in Grafton Massachusetts. Figure 1 shows the site locus.

The project locus contains approximately 62.9 acres of land. The existing property is presently undeveloped and consists of one lot. The site consists of mainly wooded area. The parcel has many cart paths that run throughout it as shown on Pre-Development Drainage Map. The existing topography slopes from southeast to northwest toward the wetland located in the northwest corner of the lot. The parcel also has a vernal pool located in the center of the project adjacent to Institute Road.

PROJECT DESCRIPTION

The project proponent proposes to construct a 46 lot residential development. This development is known as "The Village At Institute Road" and consists of 46 single family homes serviced by public water and sewer and driveway as shown conceptual on the Definitive Plans. The development also includes construction of three 26' wide paved roadways as shown on the plans. The proposed drainage system will consist of catch basins and drain manholes along the proposed roadways and directed to a forebay and infiltration basin.

DESCRIPTION OF EXISTING DRAINAGE FACILITIES

In present condition the project was divided into 4 drainage areas with four interest points as shown on the drainage map. The first interest point is an isolated wetland located at the center of the site adjacent to Institute Road. The second interest point is the property line to the west of the project. The third interest point is the wetland located in the northwest corner and the fourth interest point is the property line to the north. The drainage areas are as follows:

1. Drainage Area E1 consists of 505,535 s.f. and is made up of woodland and a portion of Institute Road. This Drainage Area flows from the site toward the wetland located adjacent to the Institute Road. This is a vernal pool and isolated wetland(IP#1).
2. Drainage Area E2 consists of 657,869 s.f. of woodland area with gravel cart paths that run through the drainage area. This runoff flows toward the west property line.(IP#2)
3. Drainage Area E3 consists of 1,013,232 s.f. of woodland area, existing site adjacent to the project. This drainage area flows overland toward large wetland located in the northwest corner of the lot. (#IP3)
4. Drainage Area E4 consists of 562,837 s.f. of woodland area that flows overland offsite toward the north. (IP#4)
5. All Drainage Areas will have roof area directed into recharge areas.

Please refer to the Pre-Development Plan.

DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

In the proposed state there will be four (4) general runoff areas. They are as follows:

1. Drainage Area 1P consists of 229,821 s.f. and will be direct runoff into the existing wetland located adjacent to Institute Road, which is also a vernal pool. This area consists of a grass area along the back of the proposed house, portion of driveways and roofs from the proposed houses and woodland areas that will remain undisturbed and portion of Institution Road. (#IP1P)
2. Drainage area 2P consists of 285,076 s,f, and will be direct runoff toward the west property line. This area consists of a grass area in backt yards along the new street and portion of driveways and roofs from the proposed houses and portion of proposed street. (#IP2P)
3. Drainage area 3P consists of 1,722,042 s.f. and the runoff generated will be collected by catch basins in proposed roadways and directed into proposed forebay and then into proposed infiltration basin. The area will discharge into wetlands located in the northwest corner of project. This area consists of a grass area, wooded area, driveway and portion of the new street as well as portion of existing street. (#IP3P)
4. Drainage area 4P will be runoff collected by drainage channel along portion of new street and directed into basin#2 and emptied into the 50' no disturb area prior to the wetlands located within the center of the parcel. This area consists of a grass area in the front yards along the new street and portion of driveways and roofs from the proposed houses and portion of proposed street. (#IP2)

CALCULATION PROCEDURE

Procedures developed by the U. S. Department of Agriculture Soil Conservation Service (SCS) as found in Technical Release 20 (TR20) were used to determine the rates and volumes of runoff generated by the study area. Calculations were performed using the computer program "HydroCAD" by Applied Microcomputer Systems, which has incorporated these SCS procedures. Pipe capacities were determined using Manning's Equations.

Runoff Areas are shown on the attached Drainage Area Plans. Calculation was done for the Two (2), Ten (10), Twenty Five (25), Fifty (50) and One Hundred-(100) Year storms. Rainfall depths used for these storms were 3.28, 5.29, 6.92, 8.62 and 10.64 inches respectively. Calculation summaries are attached to this report.

SOIL MAPS

The SCS has also performed soil mapping of the South Worcester County. The soils mapping indicate that the site is located within Hydrologic Soil Group B, See the Pre & Post Development Plans. Deep hole tests and perc tests were done throughout the Site refer, to the Grading Plan for locations. Deep test hole results indicate that the proposed underground basins are located in loamy sand & gravelly material and have a perc rate of less than 10 minutes per inch.

POLLUTANT REMOVAL

This project will incorporate facilities that will collect stormwater pollutants. Collection of pollutants will be accomplished by:

- | | |
|---------------------------|-----|
| a. Deep sump catch basins | 25% |
| b. Forebay | 25% |
| c. Infiltration Basins | 80% |
| d. Settling Basin | 25% |
| e. Grass Swale | 25% |
- (Refer to attached worksheets)

SUMMARY REACH IP#1
 (Wetlands – Vernal Pool)

Storm Event	Pre-Development		Post-Development	
2 yr.	7.87	cfs	0.903	af
10 yr.	20.19	cfs	2.232	af
25 yr.	31.34	cfs	3.464	af
50 yr.	43.40	cfs	4.828	af
100 yr.	57.98	cfs	6.513	af

SUMMARY REACH IP#2
 (West Property Line)

Storm Event	Pre-Development		Post-Development	
2 yr.	12.50	cfs	1.180	af
10 yr.	32.18	cfs	2.916	af
25 yr.	50.13	cfs	4.524	af
50 yr.	69.42	cfs	6.304	af
100 yr.	92.73	cfs	8.503	af

SUMMARY REACH IP#3
 (Wetlands Northwest Corner Parcel)

Storm Event	Pre-Development		Post-Development	
2 yr.	15.20	cfs	2.163	af
10 yr.	37.07	cfs	5.153	af
25 yr.	56.46	cfs	7.881	af
50 yr.	77.30	cfs	10.880	af
100 yr.	102.39	cfs	14.567	af

SUMMARY REACH IP#4
 (North Property Line)

Storm Event	Pre-Development		Post-Development	
2 yr.	6.37	cfs	0.853	af
10 yr.	16.33	cfs	2.111	af
25 yr.	25.32	cfs	3.276	af
50 yr.	35.07	cfs	4.568	af
100 yr.	46.87	cfs	6.164	af

Basin Summary Table

BASINS PROPOSED CONDITIONS

<u>BASIN</u>	<u>UNITS</u>	<u>100 YR.</u>	<u>50 YR.</u>	<u>25 YR.</u>	<u>10 YR.</u>	<u>2 YR</u>
1	Qin = CFS	108.92	76.73	51.15	28.93	7.21
	Qout = CFS	102.79	68.61	47.48	27.69	6.53
	ELEV. = FT	379.78	378.47	377.17	376.16	374.94
	VOL. ST. = cf	47,242	31,681	18,766	11,232	4,354

DRAINAGE ANALYSIS

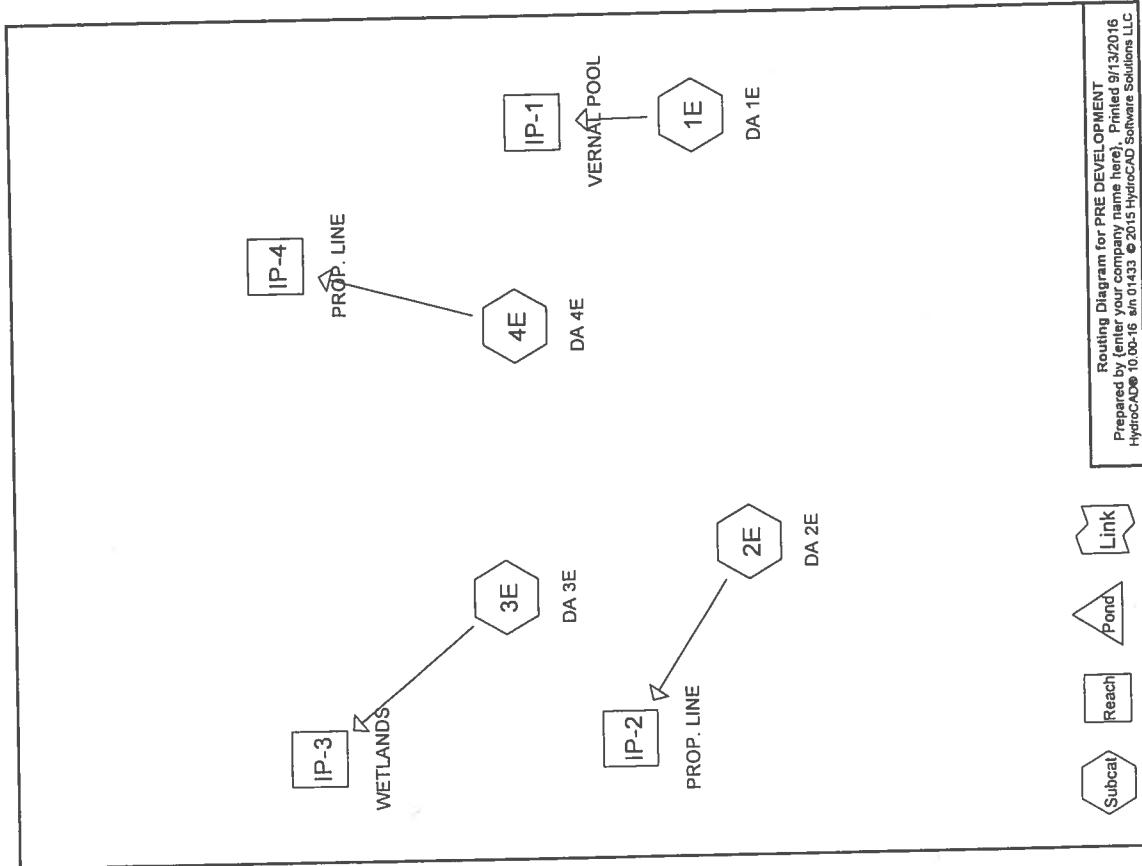
HydroCAD Calculations – Existing Conditions

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Area Listing (all nodes)

Area (elevs)	CN	Description (subcatchment-numbers)
6.108	79	<50% Grass cover, Poor, HSG B (3E)
0.932	82	Dirt roads, HSG B (1E, 2E)
0.786	98	Paved parking & roofs (3E)
55.021	73	Woods/grass comb., Poor, HSG B (1E, 2E, 3E, 4E)



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Type III 24-hr 2YR Rainfall=3.28"
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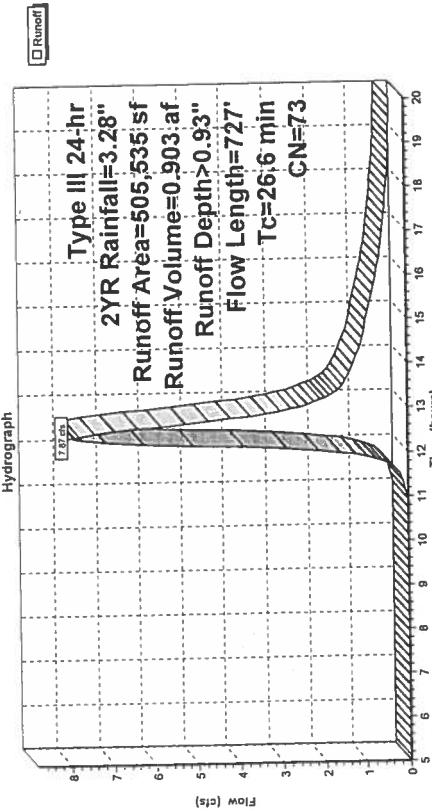
Summary for Subcatchment 1E: DA 1E

Runoff = 7.87 cfs @ 12.41 hrs, Volume= 0.903 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description			
496,983	73	Woods/grass comb., Poor, HSG B			
8,552	82	Dirt roads, HSG B			
Tc	Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
505,535	73	Weighted Average			Sheet Flow, TRAVEL PATH A TO B
505,535		100.00% Pervious Area			Woods: Dense underbrush, n= 0.800 P2= 3.20"
12.3	50	0.0200	0.07		Shallow Concentrated Flow, TRAVEL PATH B TO C
14.3	677	0.0250	0.79		Woodland Kv= 5.0 fps
26.6	727	Total			

Subcatchment 1E: DA 1E



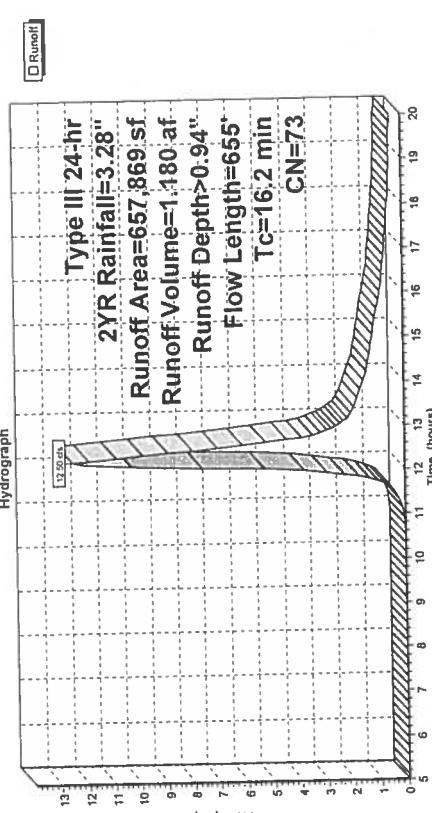
Summary for Subcatchment 2E: DA 2E

Runoff = 12.50 cfs @ 12.25 hrs, Volume= 1.180 af, Depth> 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description			
625,843	73	Woods/grass comb., Poor, HSG B			
32,026	82	Dirt roads, HSG B			
Tc	Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
657,869	73	Weighted Average			Sheet Flow, TRAVEL PATH A TO B
657,869		100.00% Pervious Area			Woods: Dense underbrush, n= 0.800 P2= 3.20"
9.9	30	0.0500	0.05		Shallow Concentrated Flow, TRAVEL PATH B TO C
6.3	625	0.1100	1.66		Woodland Kv= 5.0 ips
16.2	655	Total			

Subcatchment 2E: DA 2E



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Type III 24-hr 2YR Rainfall=3.28"
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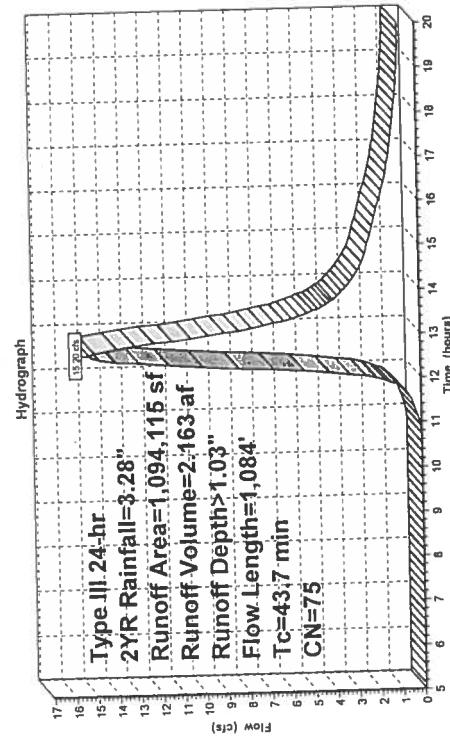
Summary for Subcatchment 3E: DA 3E

Runoff = 15.20 cfs @ 12.64 hrs, Volume= 2.163 af, Depth> 1.03"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Summary for Subcatchment 3E: DA 3E
 Runoff = 15.20 cfs @ 12.64 hrs, Volume= 2.163 af, Depth> 1.03"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description			
793,819	73	Woods/grass comb., Poor, HSG B			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34,219	98	Paved parking & roofs			
266,077	79	<50% Grass cover, Poor, HSG B			
1,094,115	75	Weighted Average			
1,059,896	96.87%	Dense underbrush			
34,219	3.13%	Impervious Area			
43.7	1.084	Total			

Subcatchment 3E: DA 3E
 Runoff



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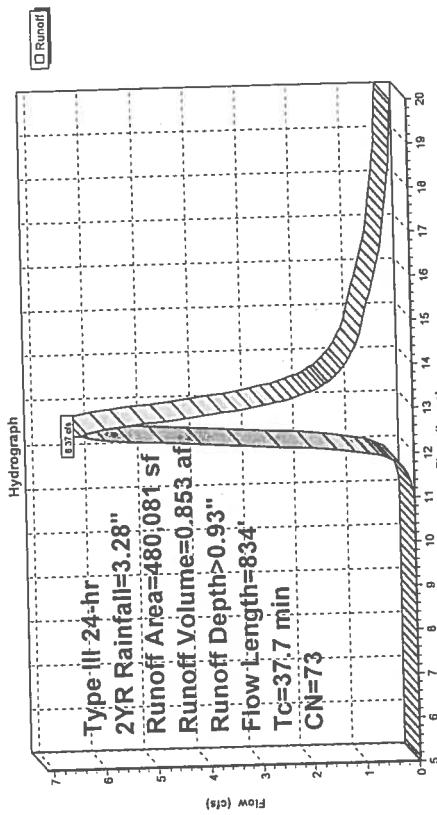
Type III 24-hr 2YR Rainfall=3.28"
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 Page 6

Summary for Subcatchment 4E: DA 4E

Runoff = 6.37 cfs @ 12.57 hrs, Volume= 0.853 af, Depth> 0.93"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description			
480,081	73	Woods/grass comb., Poor, HSG B			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03		Sheet Flow, TRAVEL PATH A TO B
9.4	784	0.0770	1.39		Shallow Concentrated Flow, TRAVEL PATH B TO C
37.7	834	Total			Woodland Kv= 5.0 cfs

Subcatchment 4E: DA 4E



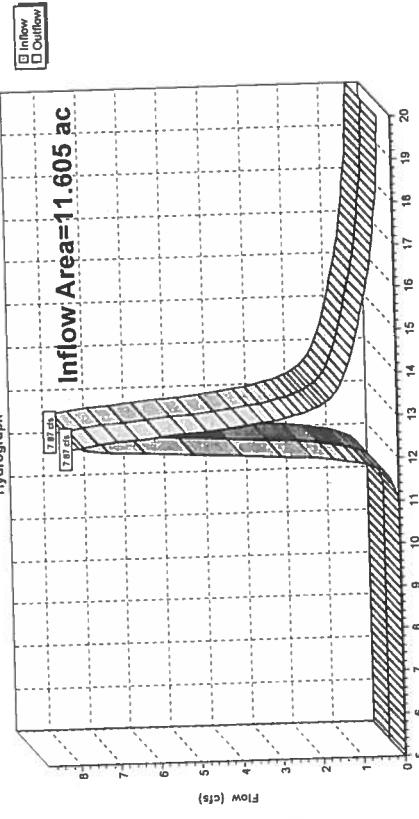
Summary for Reach IP-1: VERNAL POOL

Inflow Area = 11.605 ac, 0.00% Impervious, Inflow Depth > 0.93" for 2YR event
Inflow = 7.87 cfs @ 12.41 hrs, Volume= 0.903 af, Attenu= 0%, Lag= 0.0 min
Outflow = 7.87 cfs @ 12.41 hrs, Volume= 0.903 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL

Hydrograph



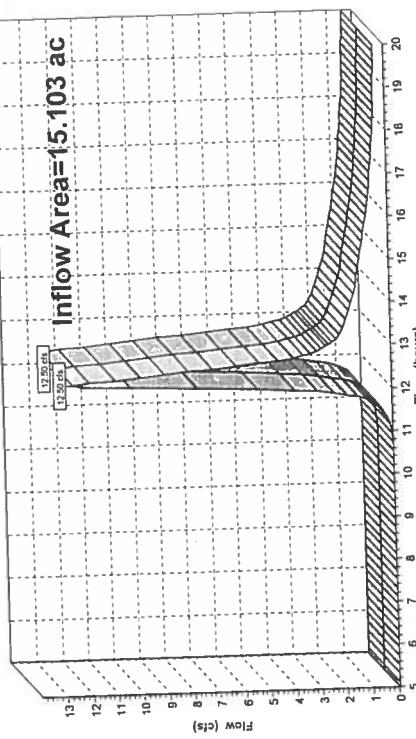
Summary for Reach IP-2: PROP. LINE

Inflow Area = 15.103 ac, 0.00% Impervious, Inflow Depth > 0.94" for 2YR event
Inflow = 12.50 cfs @ 12.25 hrs, Volume= 1.180 af, Attenu= 0%, Lag= 0.0 min
Outflow = 12.50 cfs @ 12.25 hrs, Volume= 1.180 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE

Hydrograph



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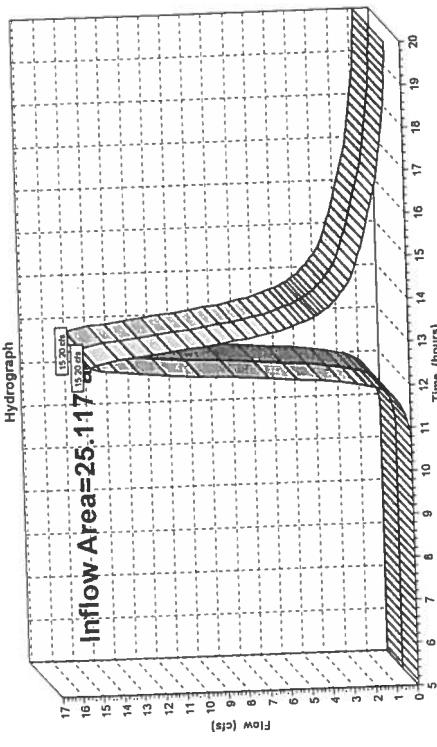
Type III 24-hr 2YR Rainfall=3.28"
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Page 2

Summary for Reach IP-3: WETLANDS

Inflow Area = 25.117 ac, 3.13% Impervious, Inflow Depth > 1.03" for 2YR event
Inflow = 15.20 cfs @ 12.64 hrs, Volume= 2.163 af, Attenu= 0%, Lag= 0.0 min
Outflow = 15.20 cfs @ 12.64 hrs, Volume= 2.163 af, Attenu= 0%, Lag= 0.0 min

Routing by StoI-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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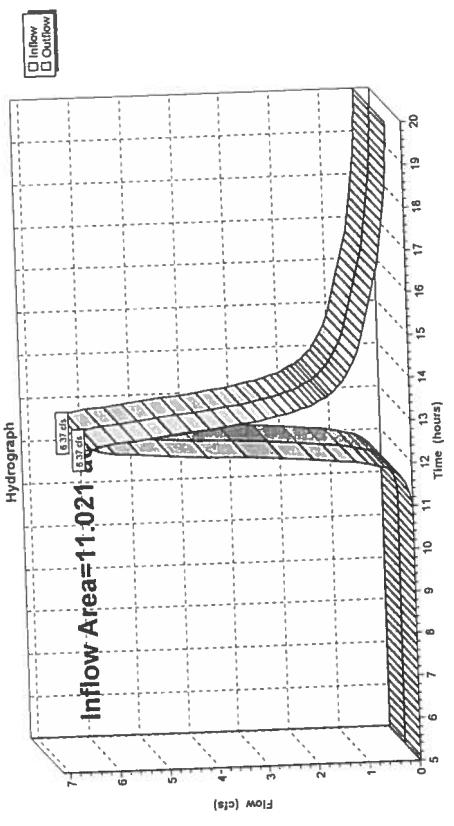
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP-4: PROP. LINE

Inflow Area = 11.021 ac, 0.00% Impervious, Inflow Depth > 0.93" for 2YR event
Inflow = 6.37 cfs @ 12.57 hrs, Volume= 0.853 af, Attenu= 0%, Lag= 0.0 min
Outflow = 6.37 cfs @ 12.57 hrs, Volume= 0.853 af, Attenu= 0%, Lag= 0.0 min

Routing by StoI-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



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Type III 24-hr 10YR Rainfall=5.29"
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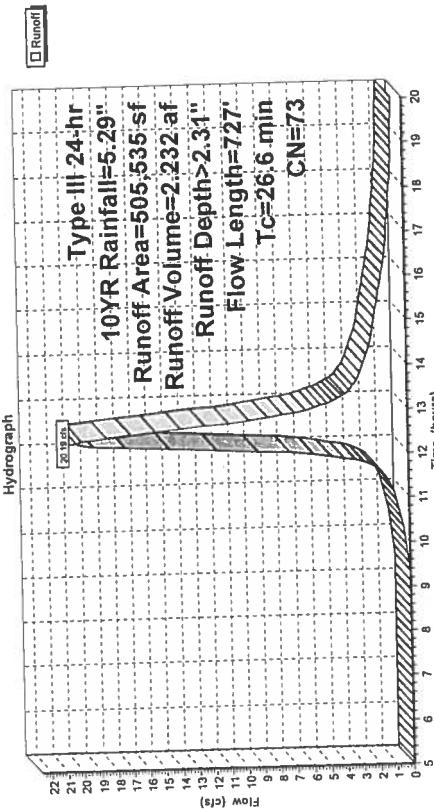
Summary for Subcatchment 1E: DA 1E

Runoff = 20.19 cfs @ 12.38 hrs, Volume= 2.232 af, Depth> 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR Rainfall=5.29"

Area (sf)					CN	Description
496,983	73	Woods/grass comb., Poor, HSG B				
Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)		Description
8,552	82	Dirt roads, HSG B				
505,535	73	Weighted Average				
505,535	73	100.00% Pervious Area				
12.3	50	0.0200	0.07	0.00		Sheet Flow, TRAVEL PATH A TO B Woods: Light underbrush n= 0.400 P2= 3.20"
14.3	677	0.0250	0.79	0.00		Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps
26.6	727	Total				

Subcatchment 1E: DA 1E



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Type III 24-hr 10YR Rainfall=5.29"
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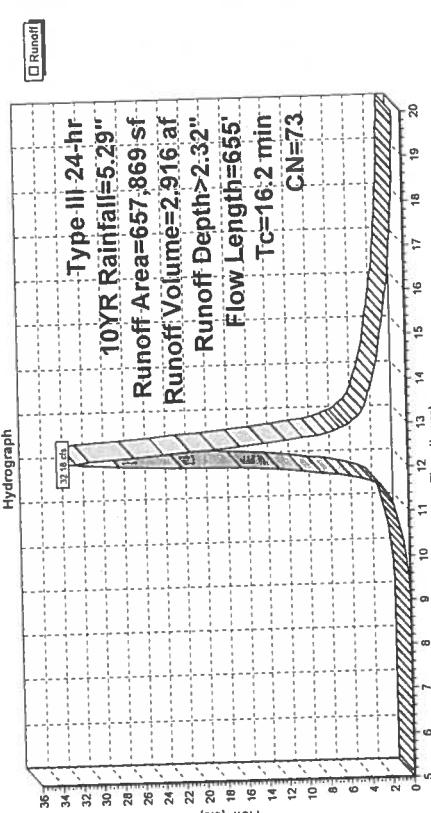
Summary for Subcatchment 2E: DA 2E

Runoff = 32.18 cfs @ 12.23 hrs, Volume= 2.916 af, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10YR Rainfall=5.29"

Area (sf)					CN	Description
625,843	73	Woods/grass comb., Poor, HSG B				
Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)		Description
32,026	82	Dirt roads, HSG B				
657,869	73	Weighted Average				
657,869	73	100.00% Pervious Area				
9.9	30	0.0500	0.05	0.05		Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20"
6.3	625	0.1100	1.66	1.66		Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps
16.2	655	Total				

Subcatchment 2E: DA 2E



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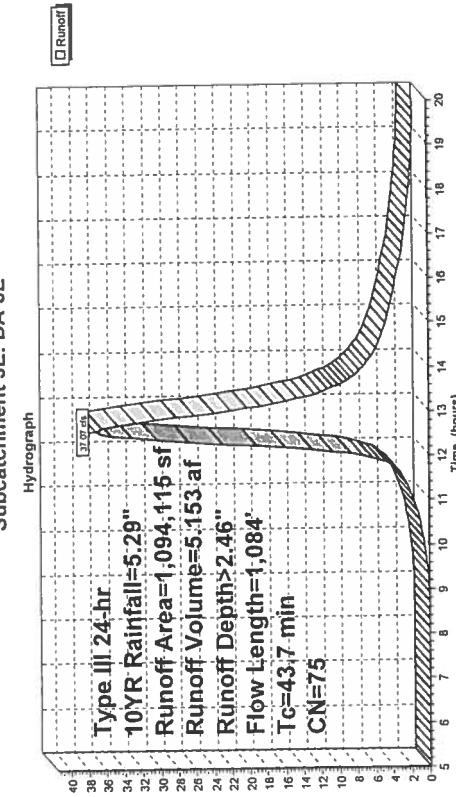
Type III 24-hr 10YR Rainfall= $I=5.29"$
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Summary for Subcatchment 3E: DA 3E

Runoff = 37.07 cfs @ 12.61 hrs, Volume= 5,153 af, Depth> 2.46"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall= $I=5.29"$

Area (sf)	C.N.	Description	Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
793,819	73	Woods/grass comb., Poor, HSG B	28.3	50	0.0100	0.03		Sheet Flow, TRAVEL PATH A TO B
34,219	98	Paved parking & roofs						Woods, Dense underbrush n=0.800 P2=3.20"
266,077	79	<50% Grass cover, Poor, HSG B						Shallow Concentrated Flow, TRAVEL PATH B TO C
1,094,115	75	96.87% Pervious Area						Woodland Kv= 5.0 ips
1,059,896		3.13% Impervious Area						
34,219								
28.3	50	0.0100	0.03					
15.4	1,034	0.0500	1.12					
43.7	1,084	Total						

Subcatchment 3E: DA 3E



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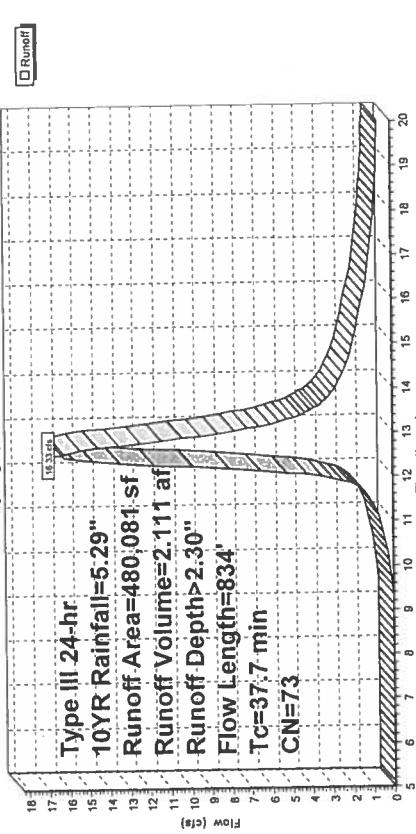
Type III 24-hr 10YR Rainfall= $I=5.29"$
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 Page 14

Summary for Subcatchment 4E: DA 4E

Runoff = 16.33 cfs @ 12.54 hrs, Volume= 2,111 af, Depth> 2.30"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall= $I=5.29"$

Area (sf)	C.N.	Description	Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
480,081	73	Woods/grass comb., Poor, HSG B	28.3	50	0.0100	0.03		Sheet Flow, TRAVEL PATH A TO B
480,081		100.00% Pervious Area						Woods, Dense underbrush n=0.800 P2=3.20"
								Shallow Concentrated Flow, TRAVEL PATH B TO C
								Woodland Kv= 5.0 ips
37.7	834	Total						

Subcatchment 4E: DA 4E



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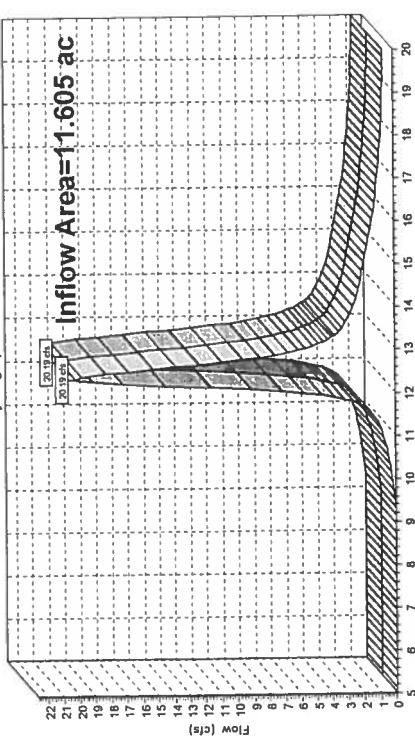
Type III 24-hr 10YR Rainfall=5.29"
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 Page 15

Summary for Reach IP-1: VERNAL POOL

Inflow Area = 11.605 ac, 0.00% Impervious, Inflow Depth > 2.31" for 10YR event
 Inflow = 20.19 cfs @ 12.38 hrs, Volume= 2.232 af
 Outflow = 20.19 cfs @ 12.38 hrs, Volume= 2.232 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL

Hydrograph



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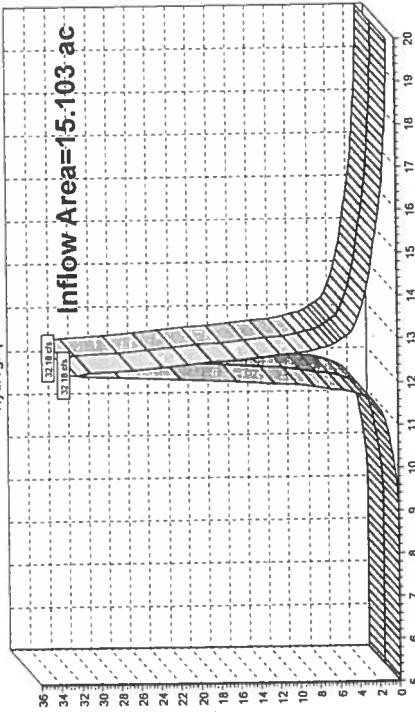
Type III 24-hr 10YR Rainfall=5.29"
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Summary for Reach IP-2: PROP. LINE

Inflow Area = 15.103 ac, 0.00% Impervious, Inflow Depth > 2.32" for 10YR event
 Inflow = 32.18 cfs @ 12.23 hrs, Volume= 2.916 af
 Outflow = 32.18 cfs @ 12.23 hrs, Volume= 2.916 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE

Hydrograph



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Type III 24-hr 10YR Rainfall=5.29"
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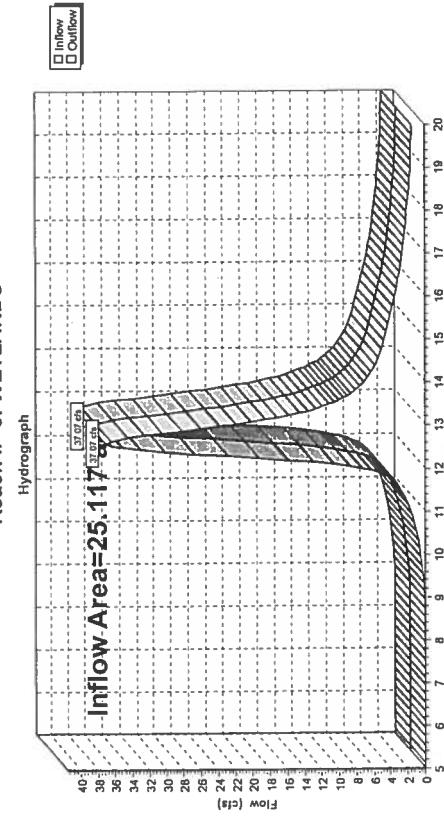
Type III 24-hr 10YR Rainfall=5.29"
Printed 9/13/2016
Page 17

Summary for Reach IP-3: WETLANDS

Inflow Area = 25.117 ac, 3.13% Impervious, Inflow Depth > 2.46" for 10YR event
Inflow = 37.07 cfs @ 12.61 hrs, Volume= 5.153 af
Outflow = 37.07 cfs @ 12.61 hrs, Volume= 5.153 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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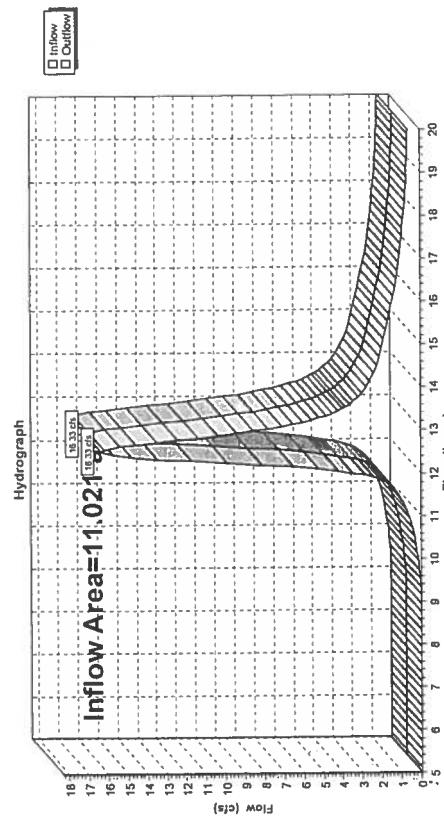
Type III 24-hr 10YR Rainfall=5.29"
Printed 9/13/2016
Page 18

Summary for Reach IP-4: PROP. LINE

Inflow Area = 11.021 ac, 0.00% Impervious, Inflow Depth > 2.30" for 10YR event
Inflow = 16.33 cfs @ 12.54 hrs, Volume= 2.111 af
Outflow = 16.33 cfs @ 12.54 hrs, Volume= 2.111 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



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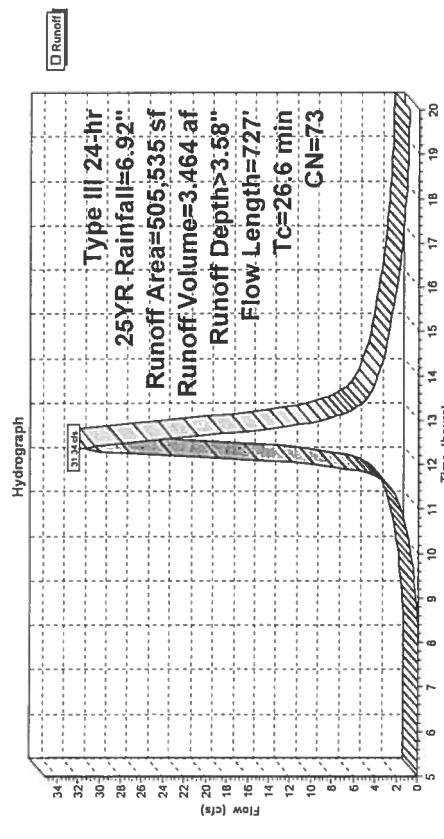
Type III 24-hr 25YR Rainfall=6.92"
 Printed 9/13/2016
 Page 19

Summary for Subcatchment 1E: DA 1E

Runoff = 31.34 cfs @ 12.37 hrs, Volume= 3,464 af, Depth> 3.58"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

Tc	Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07	Sheet Flow, TRAVEL PATH A TO B Woods: Light underbrush n= 0.400 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 ips	
14.3	677	0.0250	0.79		
26.6	727	Total			

Subcatchment 1E: DA 1E



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Type III 24-hr 25YR Rainfall=6.92"
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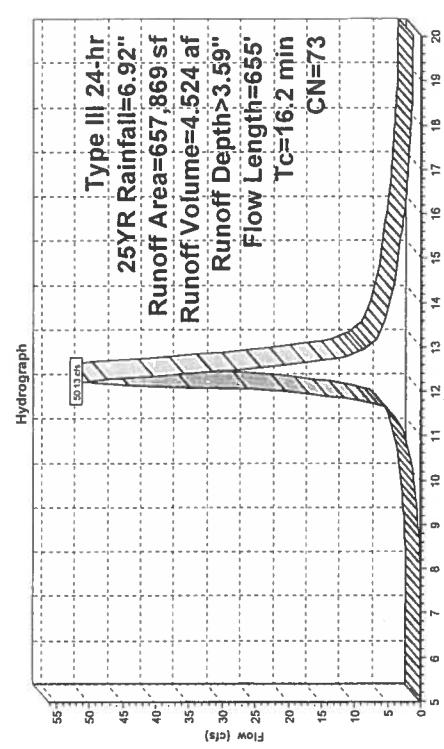
Summary for Subcatchment 2E: DA 2E

Runoff = 50.13 cfs @ 12.22 hrs, Volume= 4,524 af, Depth> 3.59"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
496.983	73	Wood/grass comb., Poor, HSG B
8,552	82	Dirt roads, HSG B
505.535	73	Weighted Average
505.535		100.00% Pervious Area
		657.869
		100.00% Pervious Area

Tc	Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 ips	
6.3	625	0.1100	1.66		
16.2	655	Total			

Subcatchment 2E: DA 2E



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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 3E: DA 3E

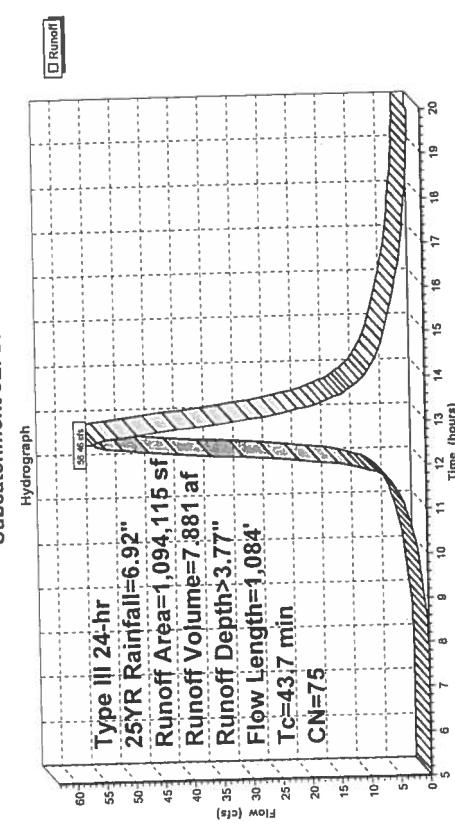
Runoff = 56.46 cfs @ 12:60 hrs, Volume= 7.881 af, Depth> 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
793,819	73	Woods/grass comb., Poor, HSG B
34,219	98	Paved parking & roofs
266,077	79	<50% Grass cover, Poor, HSG B
1,094,115	75	Weighted Average
1,059,896	96.87%	Woods: Dense underbrush n= 0.800 P2= 3.20"
34,219	3.13%	Impervious Area
Tc	Length	Slope
(min)	(feet)	(ft/ft)
28.3	50	0.0100
15.4	1.034	0.0500
43.7	1.084	Total
		0.03
		1.12
		0.03
		1.12
		0.03

Subcatchment 3E: DA 3E



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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 4E: DA 4E

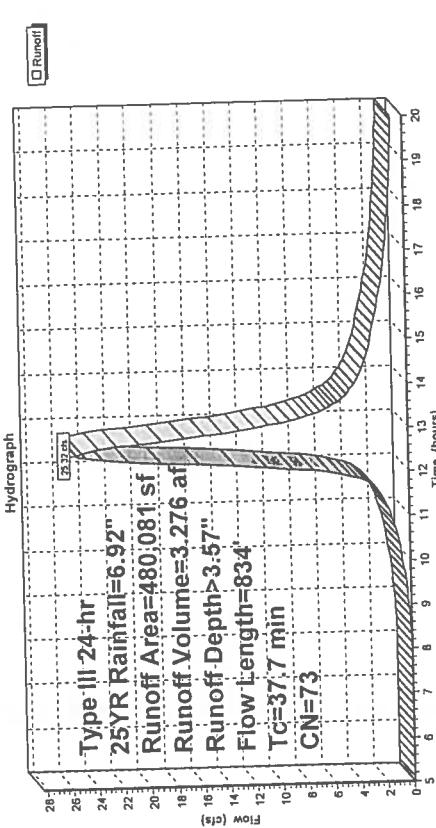
Runoff = 25.32 cfs @ 12.53 hrs, Volume= 3.276 af, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
480,081	73	Woods/grass comb., Poor, HSG B
480,081	100.00%	Pervious Area
Tc	Length	Slope
(min)	(feet)	(ft/sec)
28.3	50	0.0100
9.4	784	0.0770
37.7	834	Total

Subcatchment 4E: DA 4E



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Type III 24-hr 25YR Rainfall=6.92"
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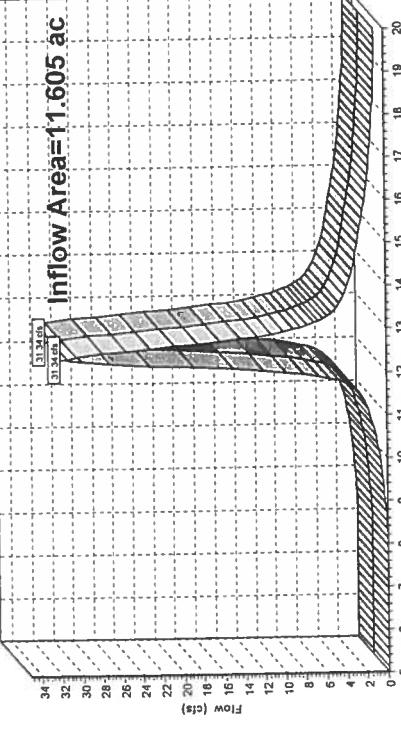
Summary for Reach IP-1: VERNAL POOL

Inflow Area = 11.605 ac, 0.00% Impervious, Inflow Depth > 3.58" for 25YR event
Inflow = 31.34 cfs @ 12.37 hrs, Volume= 3.464 af
Outflow = 31.34 cfs @ 12.37 hrs, Volume= 3.464 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL

Hydrograph



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Type III 24-hr 25YR Rainfall=6.92"
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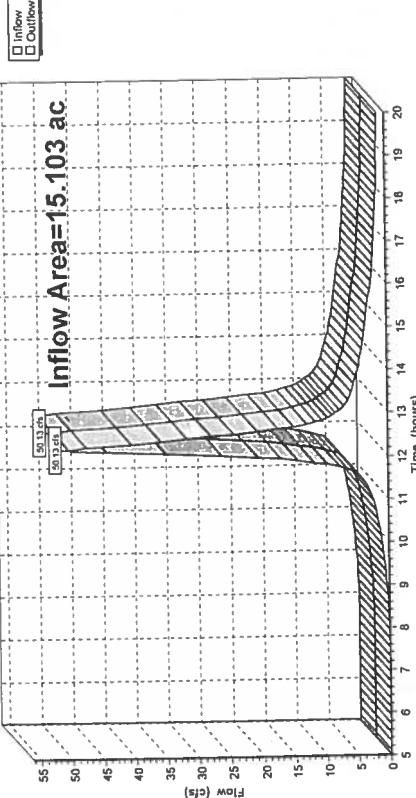
Summary for Reach IP-2: PROP. LINE

Inflow Area = 15.103 ac, 0.00% Impervious, Inflow Depth > 3.59" for 25YR event
Inflow = 50.13 cfs @ 12.22 hrs, Volume= 4.524 af
Outflow = 50.13 cfs @ 12.22 hrs, Volume= 4.524 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE

Hydrograph



Type III 24-hr 25YR Rainfall=6.92"
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Type III 24-hr 25YR Rainfall=6.92"
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Type III 24-hr 25YR Rainfall=6.92"
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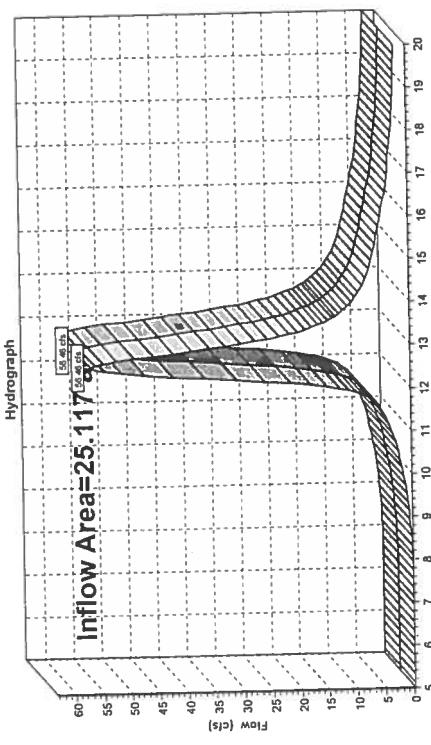
Type III 24-hr 25YR Rainfall=6.92"
Printed 9/13/2016
Page 25

Summary for Reach IP-3: WETLANDS

Inflow Area = 25.117 ac, 3.13% Impervious, Inflow Depth > 3.77" for 25YR event
Inflow = 56.46 cfs @ 12.60 hrs, Volume= 7.881 af
Outflow = 56.46 cfs @ 12.60 hrs, Volume= 7.881 af, Attenuation= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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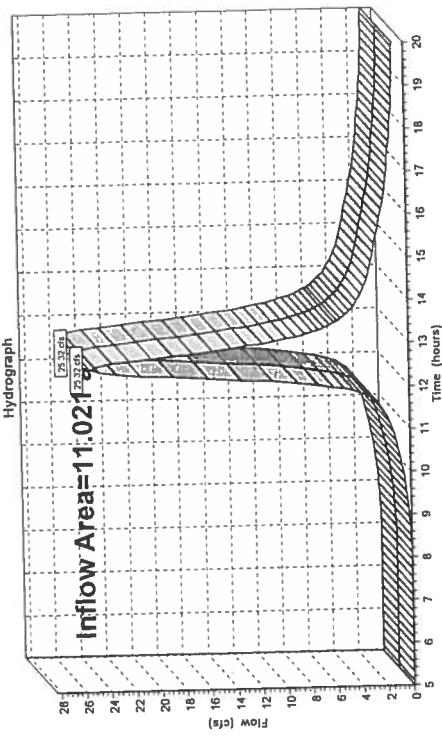
Type III 24-hr 25YR Rainfall=6.92"
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Page 26

Summary for Reach IP-4: PROP. LINE

Inflow Area = 11.021 ac, 0.00% Impervious, Inflow Depth > 3.57" for 25YR event
Inflow = 25.32 cfs @ 12.53 hrs, Volume= 3.276 af
Outflow = 25.32 cfs @ 12.53 hrs, Volume= 3.276 af, Attenuation= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



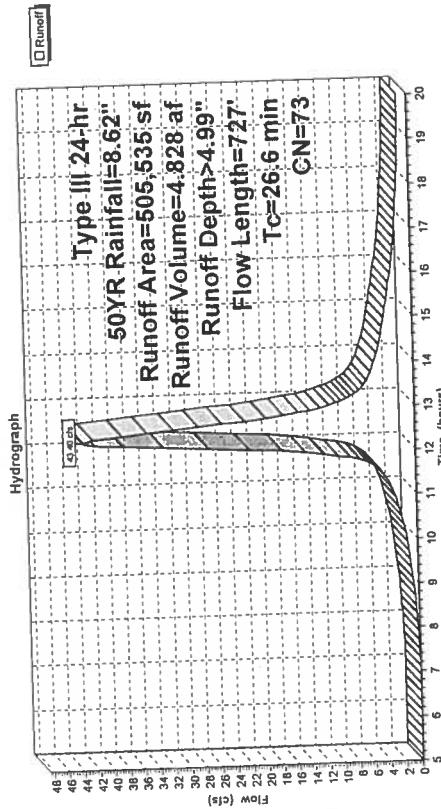
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Type III 24-hr 50YR Rainfall=8.62"
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Summary for Subcatchment 1E: DA 1E

Runoff	=	43.40 cfs @ 12.37 hrs, Volume= 4.828 af, Depth> 4.99"		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs Type III 24-hr 50YR Rainfall=8.62"				
Tc	Length (feet)	Slope (ft/ft)		
12.3	50	0.0200		
14.3	677	0.0250		
26.6	727	Total		
Area (sf) CN Description 496,933 73 Woods/grass comb., Poor, HSG B 8,532 82 Dirt roads, HSG B 505,535 73 Weighted Average 505,535 100.00% Pervious Area				
Tc	Length (feet)	Slope (ft/ft)	Capacity (cfs)	Description
9.9	30	0.0500	0.05	Sheet Flow, TRAVEL PATH A TO B
6.3	625	0.1100	1.66	Woods: Dense underbrush n= 0.800 P2= 3.20" Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 lps
16.2	655	Total		

Subcatchment 1E: DA 1E



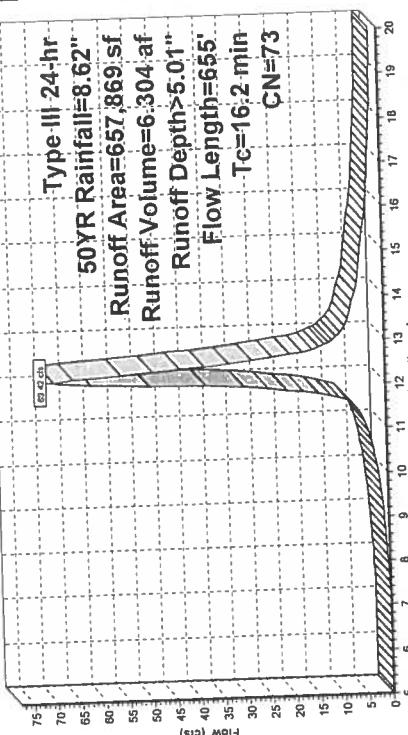
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Type III 24-hr 50YR Rainfall=8.62"
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Summary for Subcatchment 2E: DA 2E

Runoff	=	69.42 cfs @ 12.22 hrs, Volume= 6.304 af, Depth> 5.01"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs Type III 24-hr 50YR Rainfall=8.62"		

Subcatchment 2E: DA 2E



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Type III 24-hr 50YR Rainfall=8.62"
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Subcatchment 3E: DA 3E

Runoff = 77.30 cfs @ 12.59 hrs, Volume=

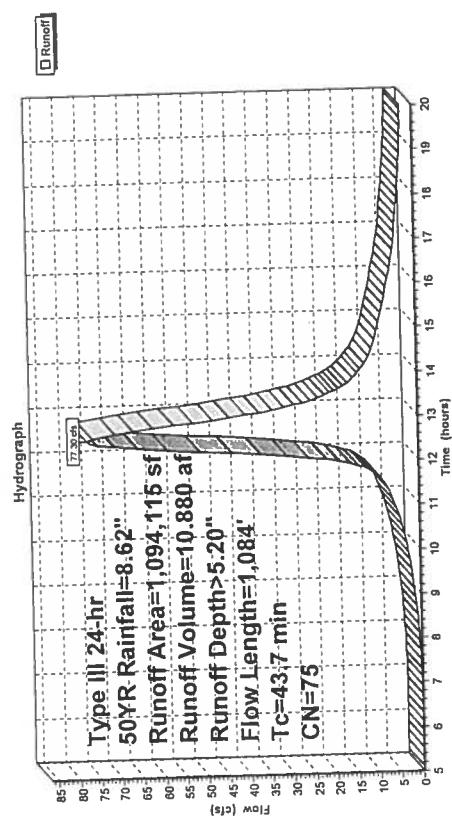
10.880 af, Depth> 5.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 50YR Rainfall=8.62"

Area (sf)	CN	Description			
793,819	73	Woods/grass comb., Poor, HSG B			
34,219	98	Paved parking & roofs			
266,077	79	<50% Grass cover, Poor, HSG B			
1,094,115	75	Weighted Average			
1,059,896	96.8%	Pervious Area			
34,219	3.13%	Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods; Dense underbrush n= 0.800	
				P2= 3.20"	
				Shallow Concentrated Flow, TRAVEL PATH B TO C	
15.4	1.034	0.0500	1.12	Woodland Kv= 5.0 fpm	
43.7	1.084	Total			

Subcatchment 3E: DA 3E



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Type III 24-hr 50YR Rainfall=8.62"
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Summary for Subcatchment 4E: DA 4E

Runoff = 35.07 cfs @ 12.52 hrs, Volume=

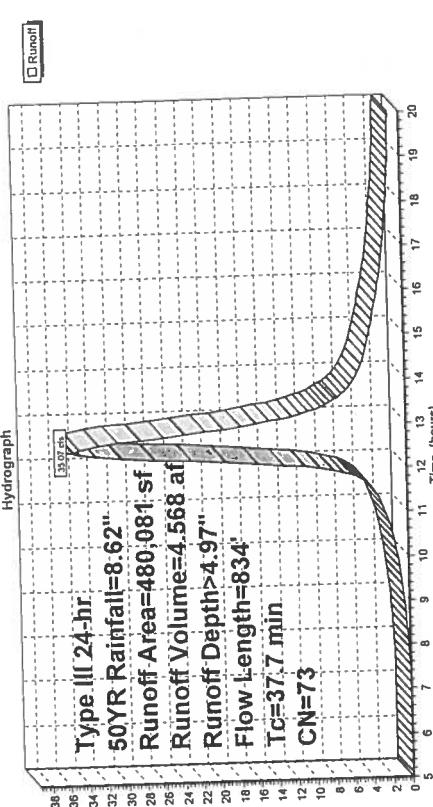
4.568 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 50YR Rainfall=8.62"

Area (sf)	CN	Description			
480,081	73	Woods/grass comb., Poor, HSG B			
480,081	100.00%	Pervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods; Dense underbrush n= 0.800	
				P2= 3.20"	
				Shallow Concentrated Flow, TRAVEL PATH B TO C	
				Woodland Kv= 5.0 fpm	
9.4	784	0.0770	1.39		
37.7	834	Total			

Subcatchment 4E: DA 4E



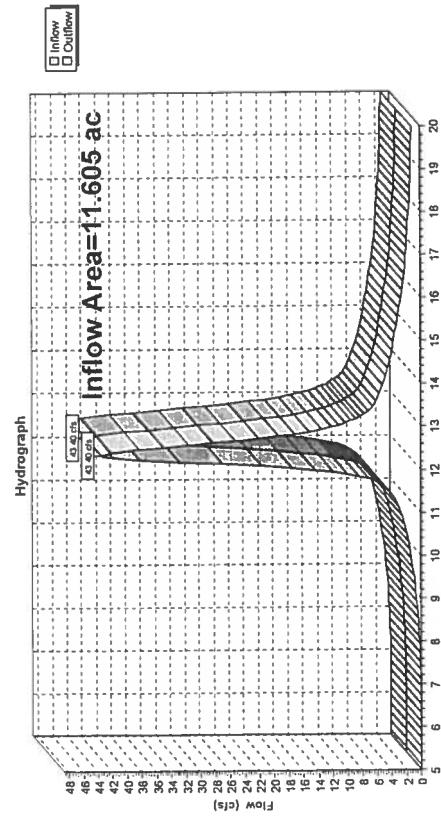
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 Type III 24-hr 50YR Rainfall=8.62"
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Summary for Reach IP-1: VERNAL POOL

Inflow Area = 11.605 ac, 0.00% Impervious, Inflow Depth > 4.99" for 50YR event
 Inflow = 43.40 cfs @ 12.37 hrs, Volume= 4.828 af
 Outflow = 43.40 cfs @ 12.37 hrs, Volume= 4.828 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL



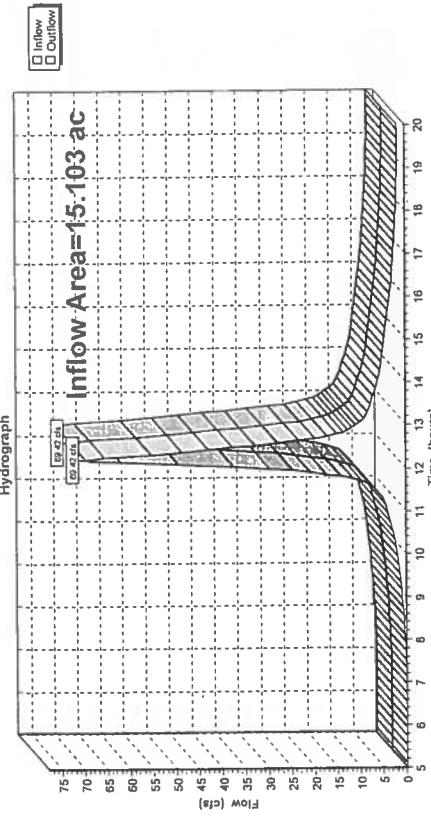
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 Type III 24-hr 50YR Rainfall=8.62"
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 Page 32

Summary for Reach IP-2: PROP. LINE

Inflow Area = 15.103 ac, 0.00% Impervious, Inflow Depth > 5.01" for 50YR event
 Inflow = 69.42 cfs @ 12.22 hrs, Volume= 6.304 af
 Outflow = 69.42 cfs @ 12.22 hrs, Volume= 6.304 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE



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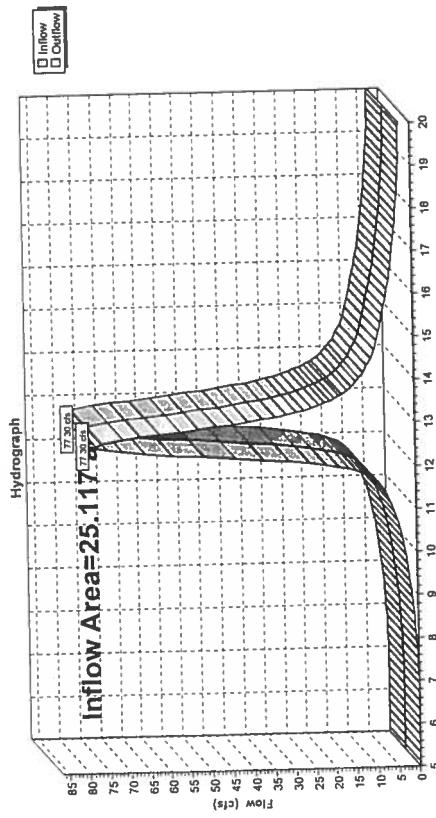
Type III 24-hr 50YR Rainfall=8.62"
 Printed 9/13/2016
 Page 33

Summary for Reach IP-3: WETLANDS

Inflow Area = 25.117 ac, 3.13% Impervious, Inflow Depth > 5.20" for 50YR event
 Inflow = 77.30 cfs @ 12.59 hrs, Volume= 10.880 af, Attenuation= 0%, Lag= 0.0 min
 Outflow = 77.30 cfs @ 12.59 hrs, Volume= 10.880 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS



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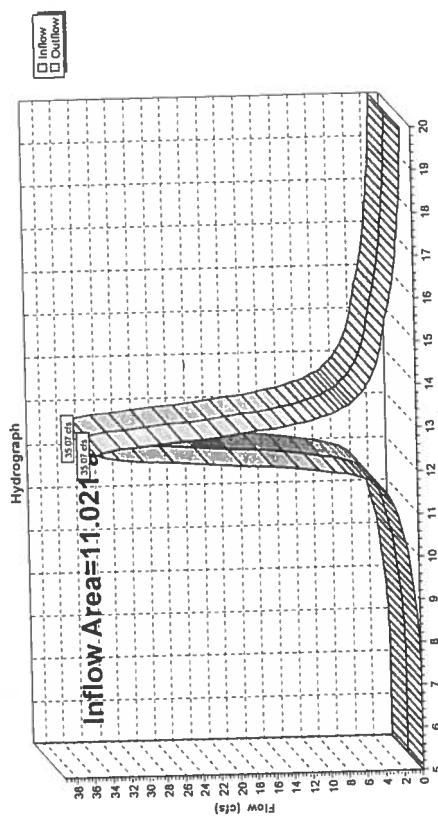
Type III 24-hr 50YR Rainfall=8.62"
 Printed 9/13/2016
 Page 34

Summary for Reach IP-4: PROP. LINE

Inflow Area = 11.021 ac, 0.00% Impervious, Inflow Depth > 4.97" for 50YR event
 Inflow = 35.07 cfs @ 12.52 hrs, Volume= 4.568 af, Attenu= 0%, Lag= 0.0 min
 Outflow = 35.07 cfs @ 12.52 hrs, Volume= 4.568 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE



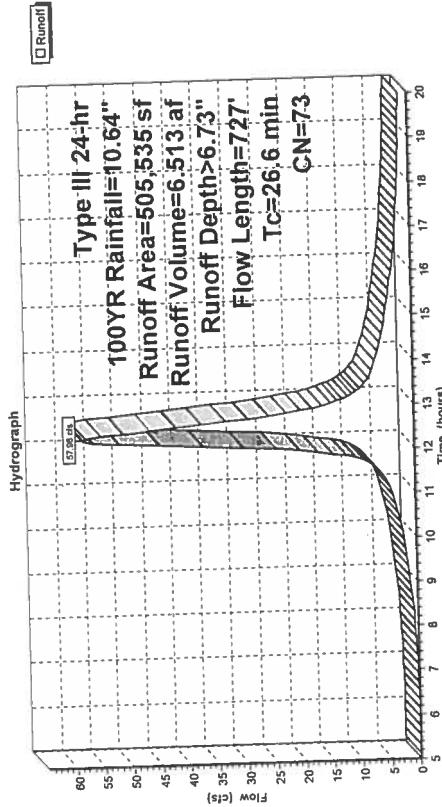
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Type III 24-hr 100YR Rainfall=10.64"
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Summary for Subcatchment 1E: DA 1E

Runoff	=	57.98 cfs @ 12.36 hrs, Volume= 6.513 af, Depth> 6.73"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs Type III 24-hr 100YR Rainfall=10.64"		
Tc	Length (feet)	Slope (ft/ft) Capacity (cfs)
12.3	50	0.0200 0.07
14.3	677	0.0250 0.79
26.6	727	Total

Subcatchment 1E: DA 1E



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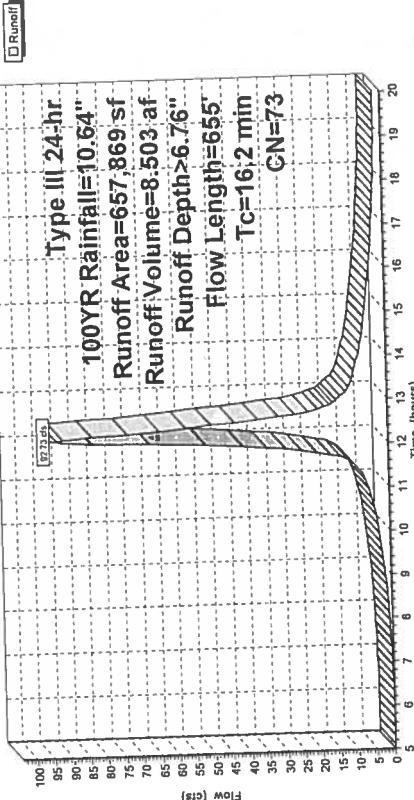
Type III 24-hr 100YR Rainfall=10.64"
 Printed 9/13/2016
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Summary for Subcatchment 2E: DA 2E

Runoff	=	92.73 cfs @ 12.22 hrs, Volume= 8.503 af, Depth> 6.76"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs Type III 24-hr 100YR Rainfall=10.64"		

Runoff	=	92.73 cfs @ 12.22 hrs, Volume= 8.503 af, Depth> 6.76"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs Type III 24-hr 100YR Rainfall=10.64"		
Tc	Length (feet)	Slope (ft/ft) Capacity (cfs)
12.3	50	0.0200 0.07
14.3	677	0.0250 0.79
26.6	727	Total

Subcatchment 2E: DA 2E



Summary for Subcatchment 3E: DA 3E

Runoff = 102.39 cfs @ 12.59 hrs, Volume=

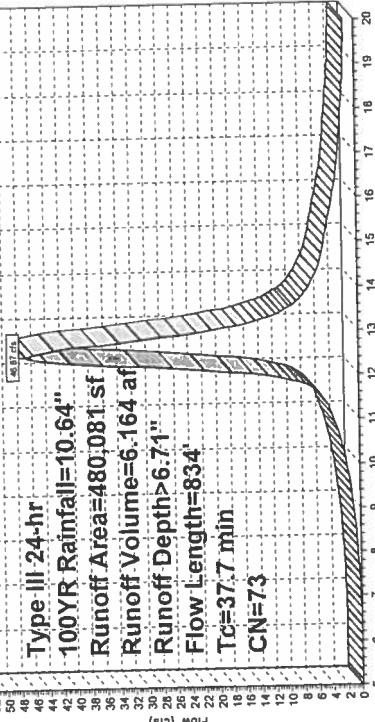
14.567 af, Depth> 6.96'

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 100YR Rainfall=10.64"

Area (sf)	CN	Description
793.819	73	Woods/grass comb, Poor, HSG B
34.219	98	Paved parking & roofs
266.077	79	<50% Grass cover, Poor, HSG B
1,084.115	75	Weighted Average
1,059.896	96	96.87% PerVIOUS Area
34.219	3	3.13% Impervious Area
Tc	Length	Slope
(min)	(feet)	(ft/ft)
28.3	50	0.0100
15.4	1.034	0.0500
43.7	1.084	Total

Hydrograph
 Runoff
 Type III 24-hr 100YR Rainfall=10.64"
 Runoff Area=1,094.115 sf
 Runoff Volume=14.567 af
 Runoff Depth>6.96'
 Flow Length=1.084'
 Tc=43.7 min
 CN=75

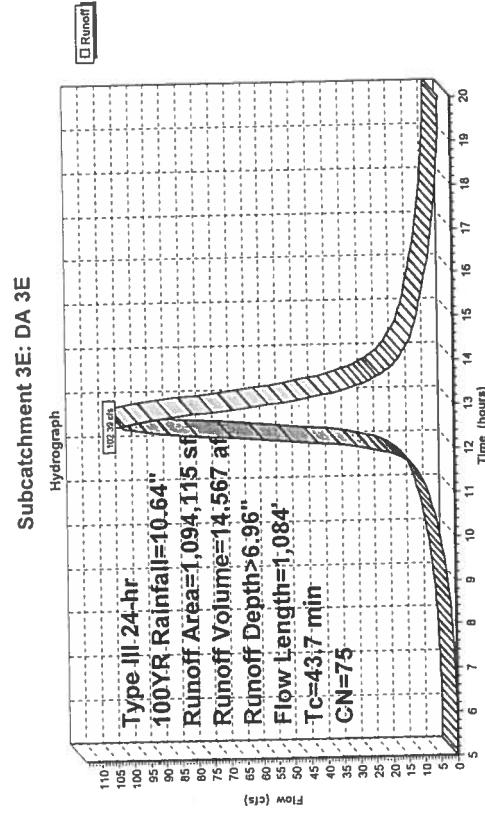


Subcatchment 4E: DA 4E

Area (sf)	CN	Description
480.081	73	Woods/grass comb, Poor, HSG B
480.081	100.00%	PerVIOUS Area

Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
28.3	50	0.0100	0.03	0.03	Sheet Flow, TRAVEL PATH A TO B Woods: Dense underbrush n= 0.800 P2= 3.20"
9.4	784	0.0770	1.39	1.39	Shallow Concentrated Flow, TRAVEL PATH B TO C Woodland Kv= 5.0 fps

Subcatchment 4E: DA 4E



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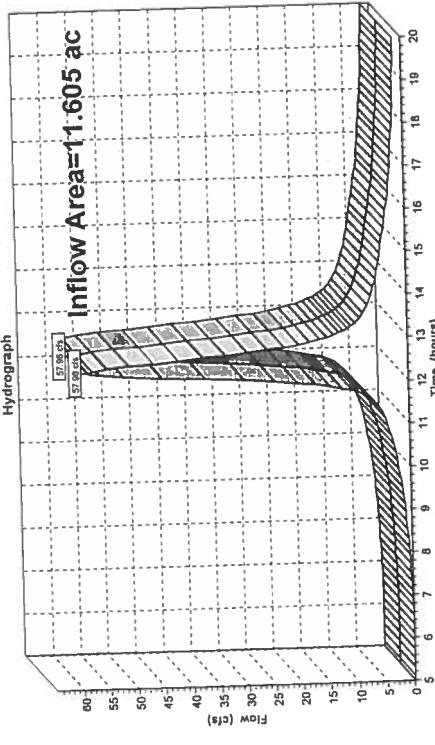
Type III 24-hr 100YR Rainfall=10.64"
 Printed 9/13/2016
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Summary for Reach IP-1: VERNAL POOL

Inflow Area = 11.605 ac, 0.00% Impervious, Inflow Depth > 6.73" for 100YR event
 Inflow = 57.98 cfs @ 12.36 hrs, Volume= 6.513 af, Atten= 0%, Lag= 0.0 min
 Outflow = 57.98 cfs @ 12.36 hrs, Volume= 6.513 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-1: VERNAL POOL



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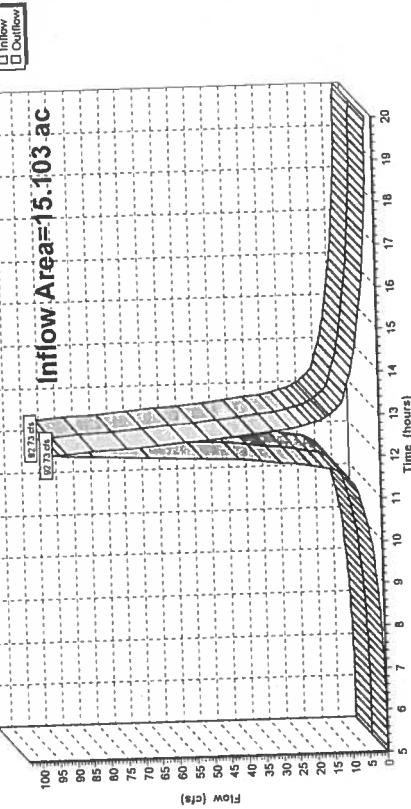
Type III 24-hr 100YR Rainfall=10.64"
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Summary for Reach IP-2: PROP. LINE

Inflow Area = 15.103 ac, 0.00% Impervious, Inflow Depth > 6.76" for 100YR event
 Inflow = 92.73 cfs @ 12.22 hrs, Volume= 8.503 af, Atten= 0%, Lag= 0.0 min
 Outflow = 92.73 cfs @ 12.22 hrs, Volume= 8.503 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-2: PROP. LINE



Type III 24-hr 100YR Rainfall=10.64"
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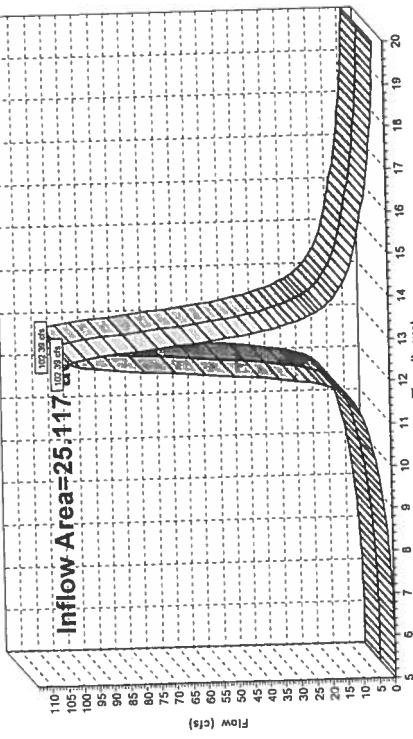
Summary for Reach IP-3: WETLANDS

Inflow Area = 25.117 ac, 3.13% Impervious, Inflow Depth > 6.96" for 100YR event
Inflow = 102.39 cfs @ 12.59 hrs, Volume= 14.567 af, Atten= 0%, Lag= 0.0 min
Outflow = 102.39 cfs @ 12.59 hrs, Volume= 14.567 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-3: WETLANDS

Hydrograph



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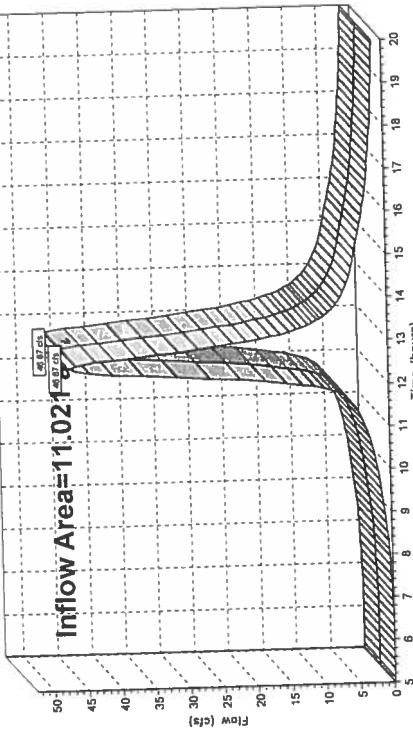
Summary for Reach IP-4: PROP. LINE

Inflow Area = 11.021 ac, 0.00% Impervious, Inflow Depth > 6.71" for 100YR event
Inflow = 46.87 cfs @ 12.51 hrs, Volume= 6.164 af, Atten= 0%, Lag= 0.0 min
Outflow = 46.87 cfs @ 12.51 hrs, Volume= 6.164 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach IP-4: PROP. LINE

Hydrograph



DRAINAGE ANALYSIS

HydroCAD Calculations – Proposed Conditions

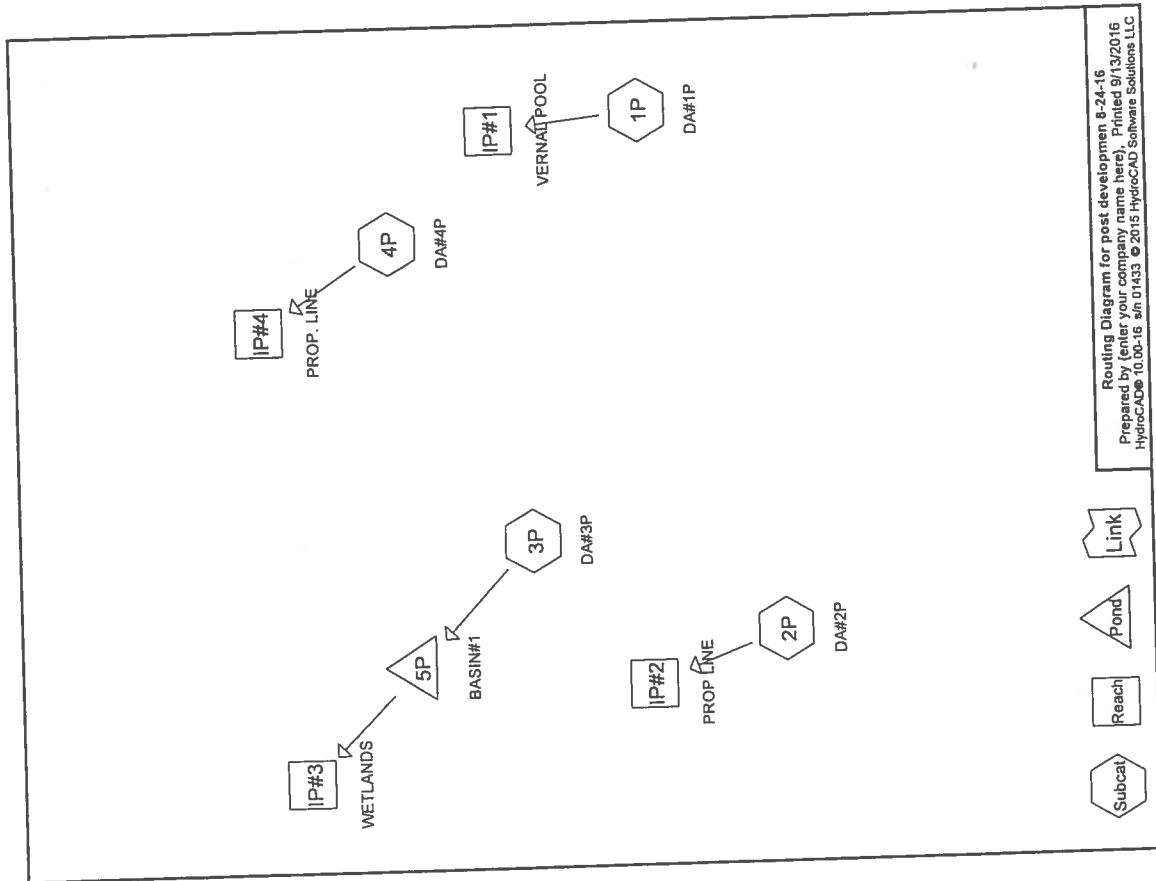
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 Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment numbers)
17.528	61	>75% Grass cover, Good, HSG B (1P, 2P, 3P, 4P)
4.162	98	Paved parking & roofs (1P, 2P, 3P, 4P)
14.541	55	Woods, Good, HSG B (3P)
10.614	66	Woods, Poor, HSG B (1P, 4P)
2.326	73	Woods/grass comb., Poor, HSG B (2P)



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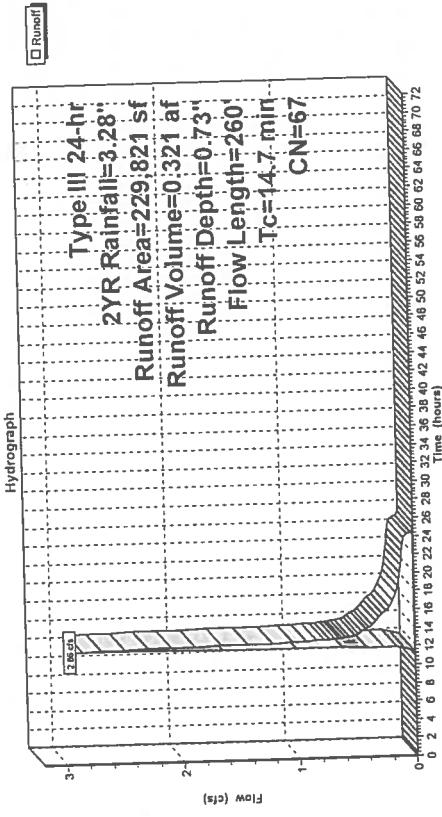
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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	0.00	0.00	1,700.0	0.0500	0.011	18.0	0.0	0.0

14.7 260 Total

Subcatchment 1P: DA#1P



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Type III 24-hr 2YR Rainfall=3.28"
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Summary for Subcatchment 2P: DA#2P

Runoff = 2.85 cfs @ 12.59 hrs, Volume= 0.450 af, Depth= 0.63"

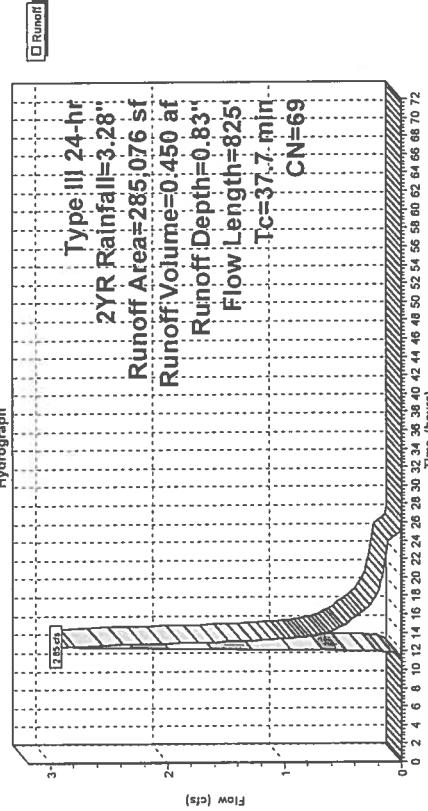
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods; Dense underbrush n=0.800 P2=3.20"	
7.1	600	0.0400	1.40	Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Short Grass Pasture Kv= 7.0 ips	
2.3	175	0.0620	1.24	Shallow Concentrated Flow, TRAVEL PATH D TO E	
				Woodland Kv= 5.0 ips	
37.7	825	Total			

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods; Dense underbrush n=0.800 P2=3.20"	
7.1	600	0.0400	1.40	Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Short Grass Pasture Kv= 7.0 ips	
2.3	175	0.0620	1.24	Shallow Concentrated Flow, TRAVEL PATH D TO E	
				Woodland Kv= 5.0 ips	
37.7	825	Total			

Subcatchment 2P: DA#2P

Hydrograph



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Type III 24-hr 2YR Rainfall=3.28"
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Summary for Subcatchment 3P: DA#3P

Runoff = 7.21 cfs @ 12.56 hrs, Volume= 1.263 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description
26,152	98	Paved parking & roofs
157,623	61	>75% Grass cover, Good, HSG B
101,301	73	Woods/grass comb., Poor, HSG B
285,076	69	Weighted Average
258,924		90.83% Perious Area
26,152		9.17% Impervious Area
31.2	2,050	Total

Runoff = 7.21 cfs @ 12.56 hrs, Volume= 1.263 af, Depth= 0.52"

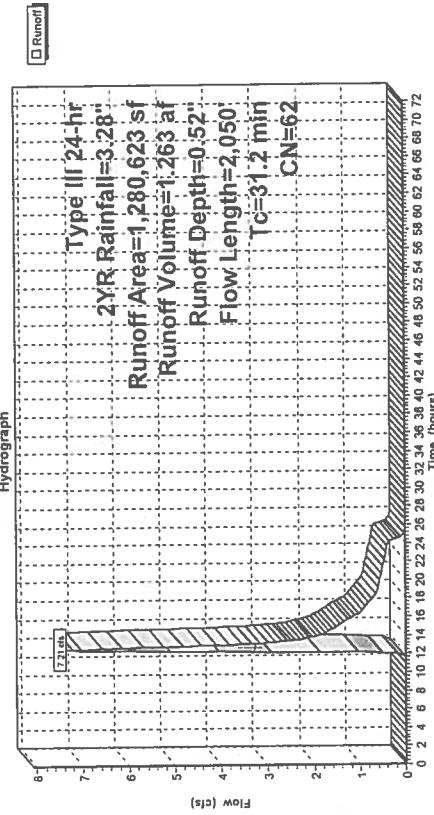
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Runoff = 7.21 cfs @ 12.56 hrs, Volume= 1.263 af, Depth= 0.52"

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Subcatchment 3P: DA#3P



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Summary for Subcatchment 4P: DA#4P

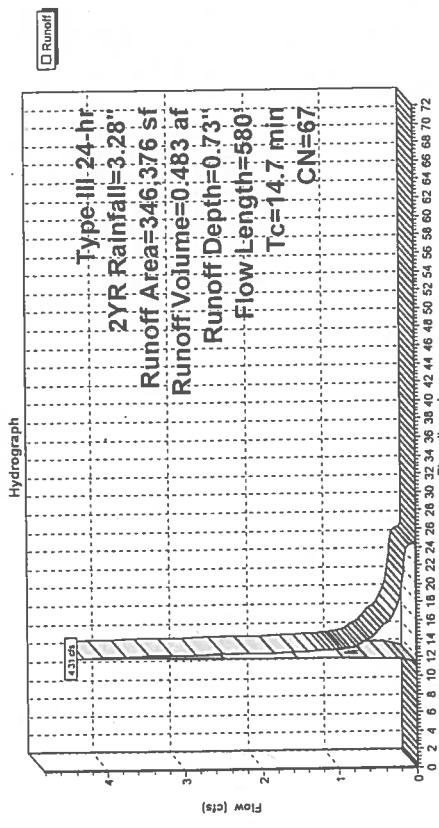
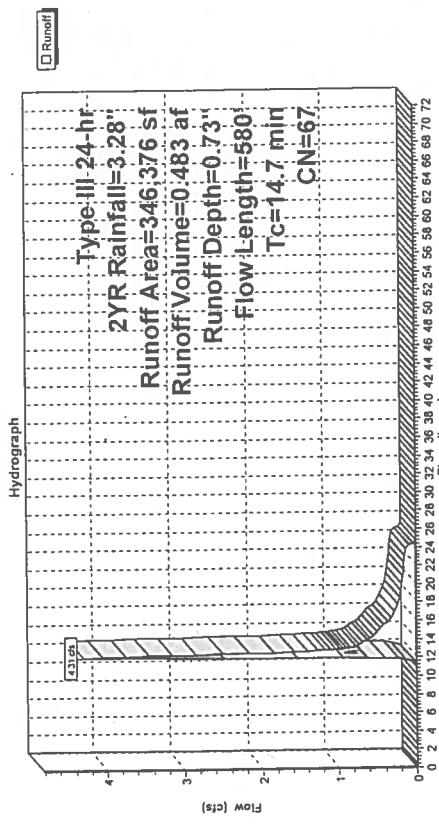
Runoff = 4.31 cfs @ 12:24 hrs, Volume= 0.483 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2YR Rainfall=3.28"

Area (sf)	CN	Description			
15,358	98	Paved parking & roofs			
48,009	61	>75% Grass cover, Good, HSG B			
283,009	66	Woods, Poor, HSG B			
346,376	67	Weighted Average			
331,018	95.57%	Pervious Area			
15,358	4.43%	Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		Sheet Flow, TRAVEL PATH A TO B
0.3	80	0.0750	4.41		Grass: Short n= 0.150 P2= 3.20"
9.3	450	0.0260	0.81		Shallow Concentrated Flow, TRAVEL PATH B TO C
					Unpaved Kv= 16.1 ips
					Shallow Concentrated Flow, TRAVEL PATH C TO D
					Woodland Kv= 5.0 ips

14.7 580 Total

Subcatchment 4P: DA#4P



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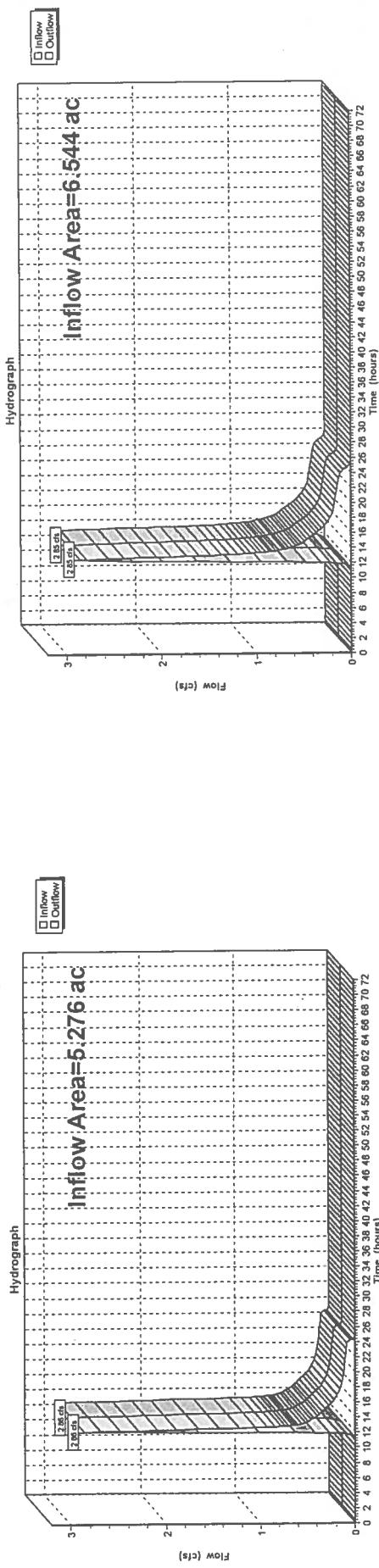
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP#1: VERNAL POOL

Inflow Area = 5.276 ac, 5.30% Impervious, Inflow Depth = 0.73" for 2YR event
Inflow = 2.86 cfs @ 12.24 hrs, Volume= 0.321 af
Outflow = 2.86 cfs @ 12.24 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+ Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL



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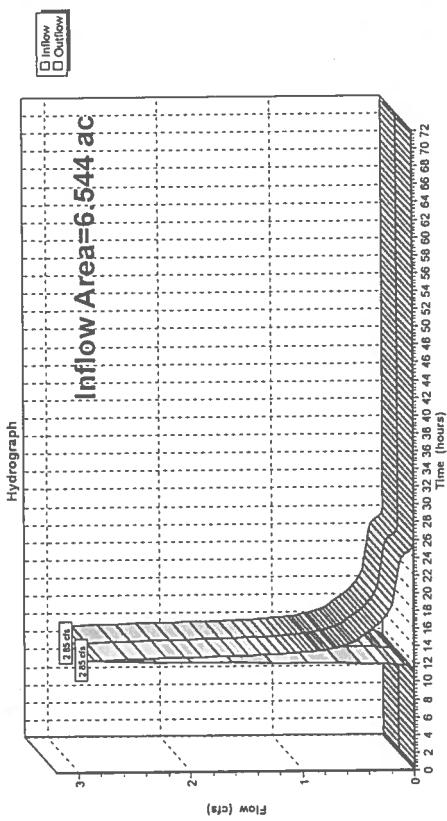
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 6.544 ac, 9.17% Impervious, Inflow Depth = 0.83" for 2YR event
Inflow = 2.85 cfs @ 12.59 hrs, Volume= 0.450 af
Outflow = 2.85 cfs @ 12.58 hrs, Volume= 0.450 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+ Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



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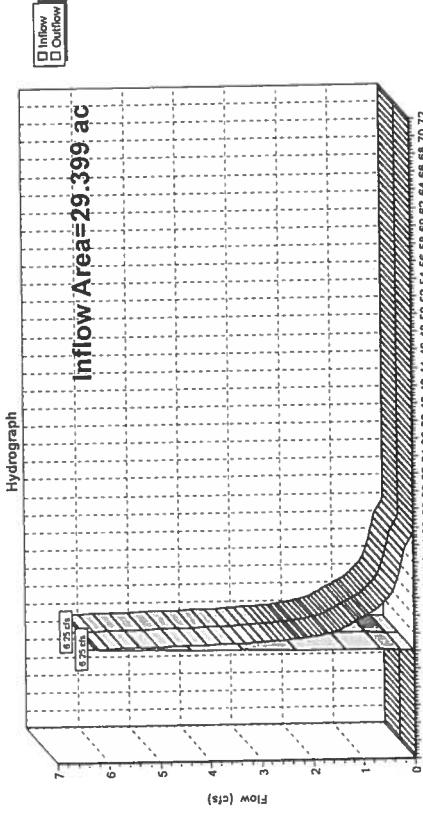
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP#3: WETLANDS

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 0.41" for 2YR event
Inflow = 6.25 cfs @ 12.71 hrs, Volume= 0.996 af
Outflow = 6.25 cfs @ 12.71 hrs, Volume= 0.996 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS



Time [hours] 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

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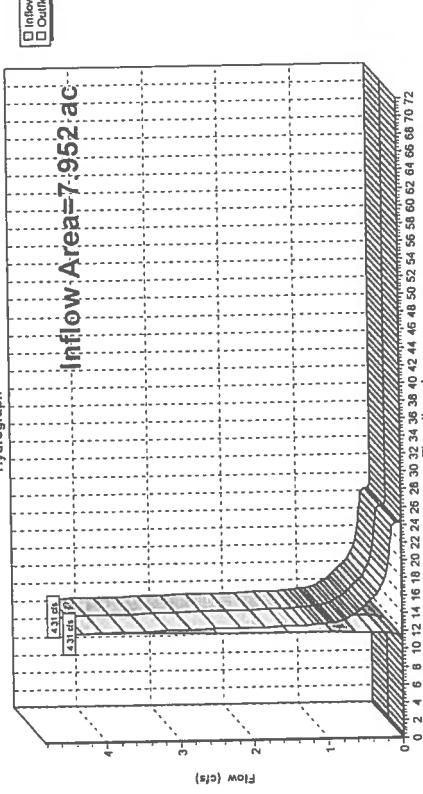
Type III 24-hr 2YR Rainfall=3.28"
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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 0.73" for 2YR event
Inflow = 4.31 cfs @ 12.24 hrs, Volume= 0.483 af
Outflow = 4.31 cfs @ 12.24 hrs, Volume= 0.483 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#4: PROP. LINE



Time [hours] 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

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Type III 24-hr 2YR Rainfall=3.28"
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Summary for Pond 5P: BASIN#1

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 0.52" for 2YR event
 Inflow = 7.21 cfs @ 12.56 hrs, Volume= 1.263 af
 Outflow = 6.53 cfs @ 12.71 hrs, Volume= 1.263 af, Attent= 9%, Lag= 8.7 min
 Discarded = 0.28 cfs @ 12.71 hrs, Volume= 0.267 af
 Primary = 6.25 cfs @ 12.71 hrs, Volume= 0.996 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 374.94' @ 12.71 hrs Surf.Area= 5,069 sf Storage= 4,354 cf
 Plug-Flow detention time=18.6 min calculated for 1.262 af (100% of inflow)
 Center-of-Mass det. time= 18.6 min (948.6 - 930.0)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	64,442 cf	Custom Stage Data (Prismatic) listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	4,200	0	0
376.00	6,050	10,250	10,250
378.00	10,371	16,421	26,671
380.00	13,000	23,371	50,042
381.00	15,800	14,400	64,442

Device	Routing	Invert	Outlet Devices
#1	Primary	374.00'	36.0" Vert. Orifice/Grate C= 0.600
#2	Discarded	374.00'	2.410 in/hr Exfiltration over Surface area
#3	Primary	379.50'	35.0 long x 1.0 breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

#4 Primary 376.00' 12.0" Vert. Orifice/Grate C= 0.600
 #5 Primary 377.50' 18.0" Vert. Orifice/Grate C= 0.600

Discarded Outflow Max=0.28 cfs @ 12.71 hrs HV=374.94' (Free Discharge)

2=Exfiltration (Exfiltration Controls 0.28 cfs)

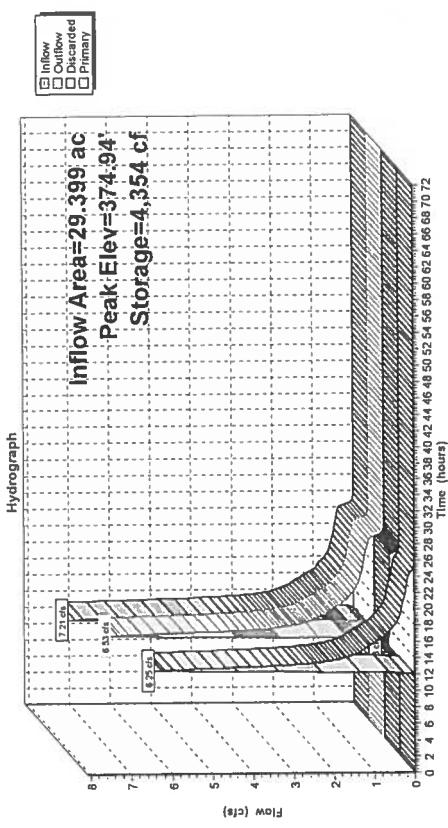
Primary Outflow Max=6.24 cfs @ 12.71 hrs HV=374.94' (Free Discharge)

1=Orifice/Grate (Orifice Controls 6.24 cfs @ 3.30 (ps)

3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

4=Orifice/Grate (Controls 0.00 cfs)

5=Orifice/Grate (Controls 0.00 cfs)



Pond 5P: BASIN#1

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Summary for Subcatchment 1P: DA#1P

Runoff = 9.13 cfs @ 12.22 hrs, Volume= 0.883 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=5.29"

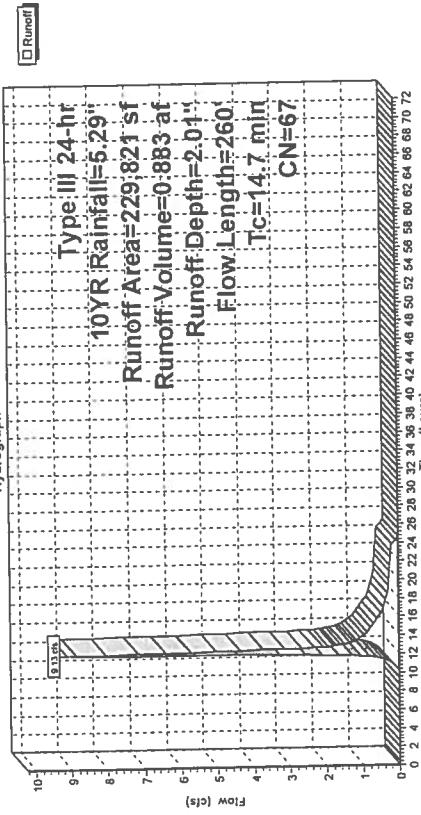
Area (sf)	CN	Description
12,172	98	Paved parking & roofs
38,295	61	>75% Grass cover, Good, HSG B
179,354	66	Woods, Poor, HSG B
229,821	67	Weighted Average
217,649		94.70% Pervious Area
12,172		5.30% Impervious Area
14.7	260	Total

Tc Length Slope Capacity Description

(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description
12.6	50	0.0200	0.07	Sheet Flow, TRAVEL PATH A TO B	
0.5	70	0.1000	2.21	Grass, Bermuda n= 0.410 P2= 3.20"	
1.6	140	0.0900	1.50	Shallow Concentrated Flow, TRAVEL PATH B TO C	
				Short Grass Pasture Kv= 7.0 ips	
				Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Woodland Kv= 5.0 ips	
14.7	260				Total

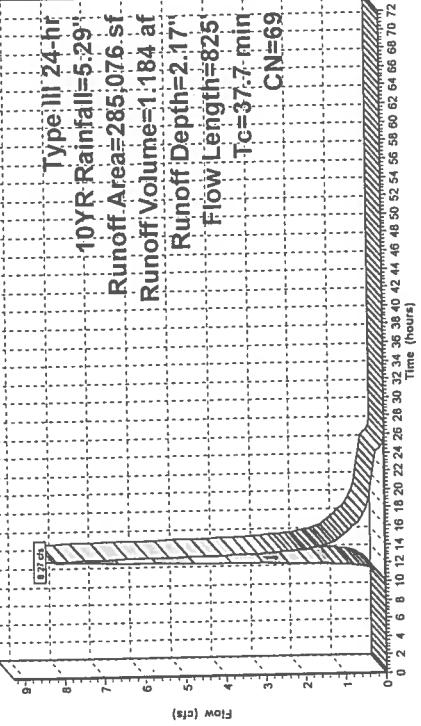
Subcatchment 1P: DA#1P

Hydrograph



Subcatchment 2P: DA#2P

Hydrograph



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Summary for Subcatchment 2P: DA#2P

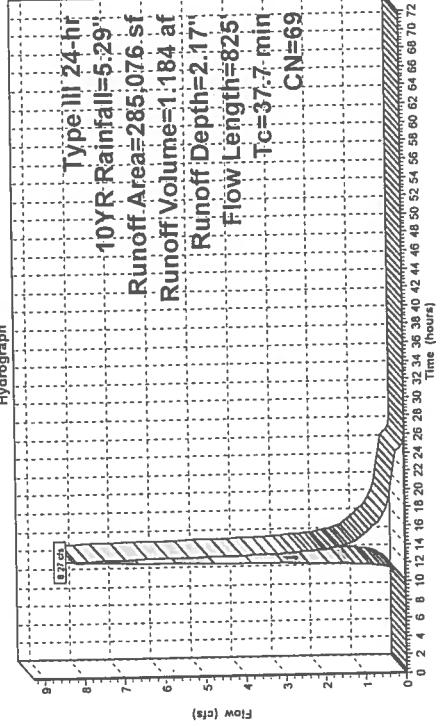
Runoff = 8.27 cfs @ 12.55 hrs, Volume= 1.184 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=5.29"

Area (sf)	CN	Description
26,152	98	Paved parking & roofs
157,623	61	>75% Grass cover, Good, HSG B
101,301	73	Woods/grass comb, Poor, HSG B
285,076	69	Weighted Average
258,924		90.83% Pervious Area
26,152		9.17% Impervious Area
37.7	825	Total

Subcatchment 2P: DA#2P

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Summary for Subcatchment 3P: DA#3P

Runoff = 28.93 cfs @ 12.48 hrs, Volume= 3.970 af, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10YR Rainfall=5.29"

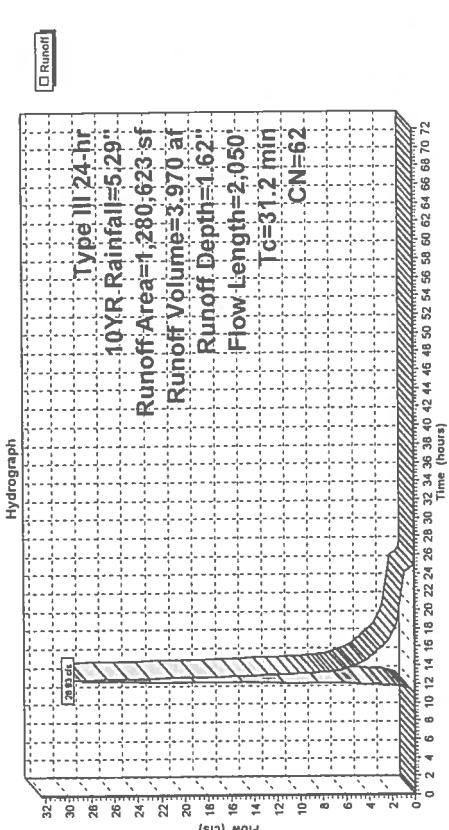
Area (sf)	CN	Description
127,629	98	Paved parking & roofs
519,577	61	>75% Grass cover, Good, HSG B
633,417	55	Woods, Good, HSG B
1,280,623	62	Weighted Average
1,152,994		90.03% Pervious Area
127,629		9.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n= 0.800 P2= 3.20"	
0.4	100	0.0600	3.94	Shallow Concentrated Flow, TRAVEL PATH B TO C	
				Unpaved Ky= 16.1 ips	
0.7	200	0.0500	4.54	Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Paved Kv= 20.3 fps	
1.8	1,700	0.0500	15.71	27.76 Pipe Channel, TRAVEL PATH E TO F	
				18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'	
				n= 0.011 Concrete pipe, straight & clean	
31.2	2,050	Total			

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Subcatchment 3P: DA#3P



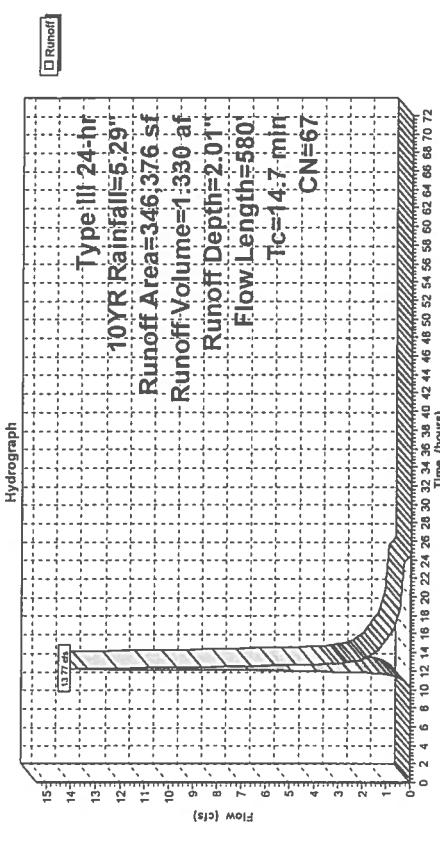
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Summary for Subcatchment 4P: DA#4P

Runoff	=	13.77 cfs @ 12.22 hrs, Volume=	1.330 af, Depth= 2.01"		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 10YR Rainfall=5.29"					
Area (sf)	CN	Description			
15,358	98	Paved parking & roofs			
48,009	61	>75% Grass cover, Good, HSG G			
283,098	66	Woods, Poor, HSG B			
346,375	67	Weighted Average			
331,018	95.57%	Pervious Area			
15,358	4.43%	Impervious Area			
Tc	Length (min)	Slope (feet/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		Sheet Flow, TRAVEL PATH A TO B
					Grass: Short n= 0.150 P2= 3.20"
0.3	80	0.0750	4.41		Shallow Concentrated Flow, TRAVEL PATH B TO C
					Unpaved Kv= 16.1 fps
9.3	450	0.0260	0.81		Shallow Concentrated Flow, TRAVEL PATH C TO D
					Woodland Kv= 5.0 fps
14.7	580	Total			

Subcatchment 4P: DA#4P



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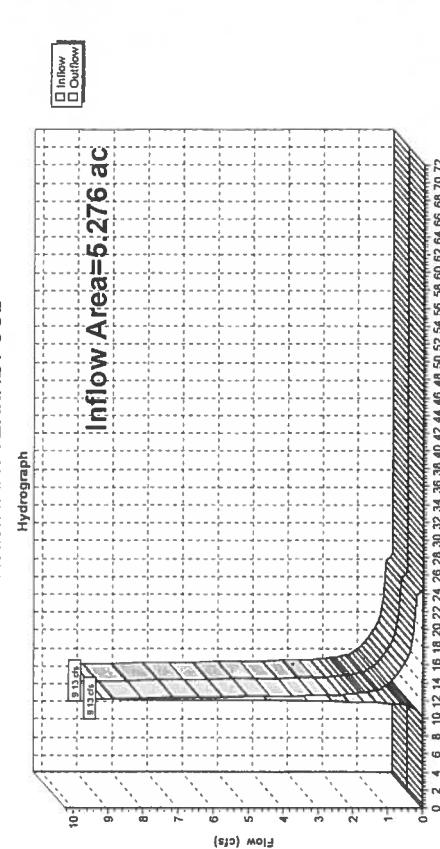
Type III 24-hr 10YR Rainfall=5.29"
 Printed 9/13/2016
 Page.19

Summary for Reach IP#1: VERNAL POOL

Inflow Area = 5.276 ac, 5.30% Impervious, Inflow Depth = 2.01" for 10YR event
 Inflow = 9.13 cfs @ 12.22 hrs, Volume= 0.883 af
 Outflow = 9.13 cfs @ 12.22 hrs, Volume= 0.883 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL

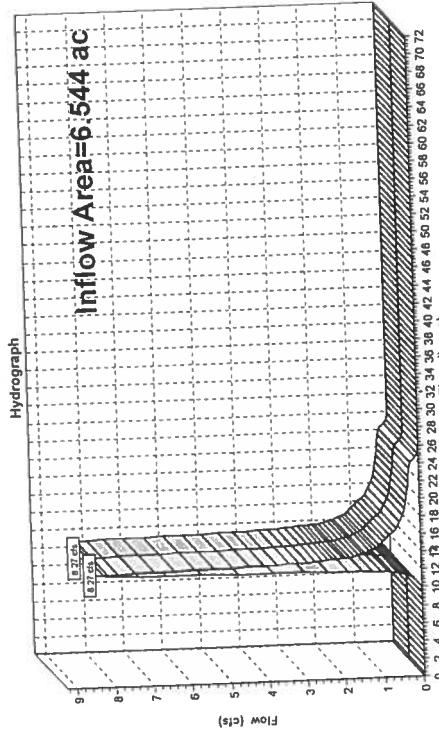


Type III 24-hr 10YR Rainfall=5.29"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 6.544 ac, 9.17% Impervious, Inflow Depth = 2.17" for 10YR event
 Inflow = 8.27 cfs @ 12.55 hrs, Volume= 1.184 af
 Outflow = 8.27 cfs @ 12.55 hrs, Volume= 1.184 af, Atten= 0%, Lag= 0.0 min
 Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dI= 0.05 hrs

Reach IP#2: PROP LINE

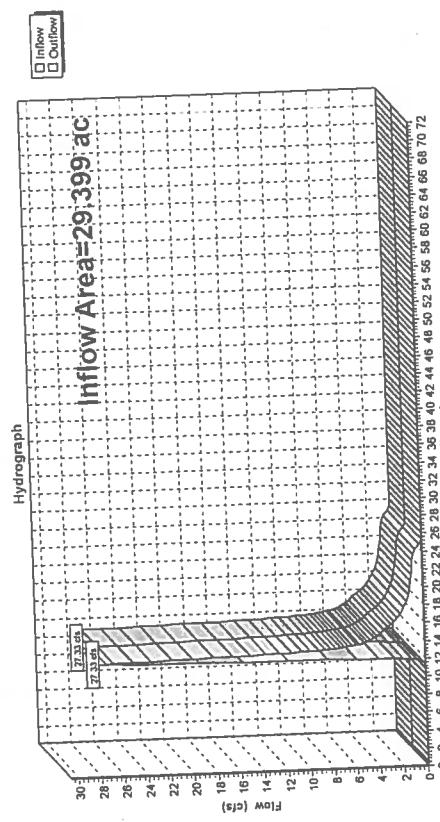


Type III 24-hr 10YR Rainfall=5.29"
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Summary for Reach IP#3: WETLANDS

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 1.50" for 10YR event
 Inflow = 27.33 cfs @ 12.57 hrs, Volume= 3.665 af
 Outflow = 27.33 cfs @ 12.57 hrs, Volume= 3.665 af, Atten= 0%, Lag= 0.0 min
 Routing by StoR-Ind+Trans method, Time Span= 0.00-72.00 hrs, dI= 0.05 hrs

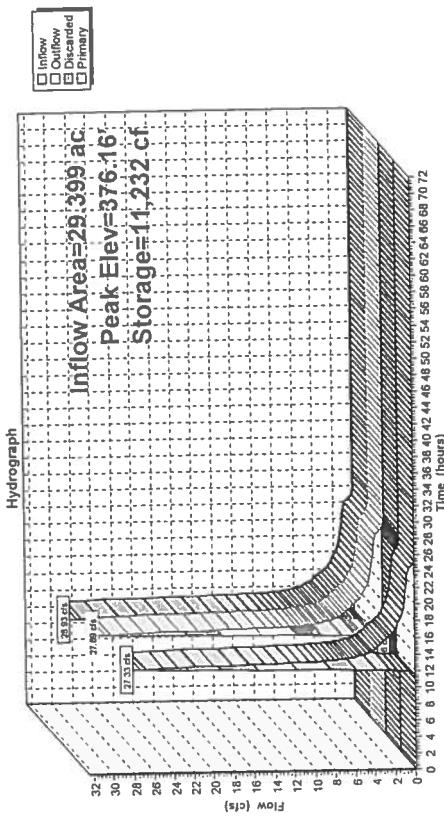
Reach IP#3: WETLANDS



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Pond 5P: BASIN#1



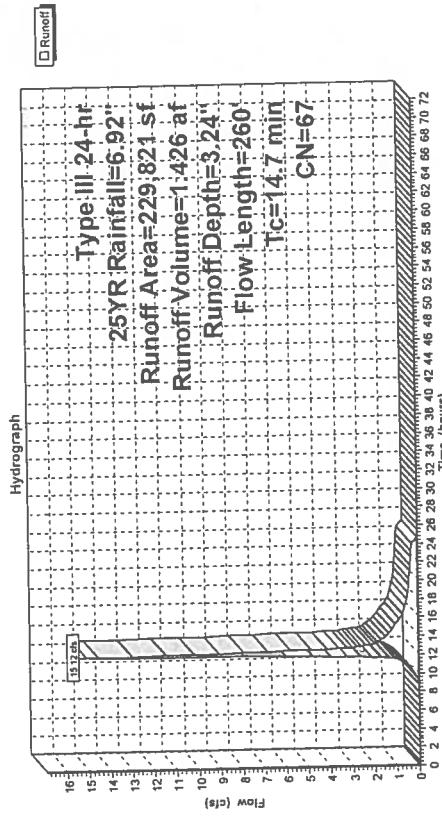
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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 1P: DA#1P

Runoff	=	15.12 cfs @ 12.21 hrs. Volume=	1.426 af, Depth= 3.24"		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 25YR Rainfall=6.92"					
Area (sf)	CN	Description			
12,172	98	Paved parking & roofs			
38,295	61	>75% Grass cover, Good, HSG B			
179,354	66	Woods, Poor, HSG B			
229,821	67	Weighted Average			
217,649		94.70% Pervious Area			
12,172		5.30% Impervious Area			
Tc	Length (min)	Slope (feet/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	50	0.0200	0.07		Sheet Flow, TRAVEL PATH A TO B
					Grass: Bermuda n= 0.410 P= 3.20"
0.5	70	0.1000	2.21		Shallow Concentrated Flow, TRAVEL PATH B TO C
1.6	140	0.0900	1.50		Short Grass Pasture Kv= 7.0 lps
					Shallow Concentrated Flow, TRAVEL PATH C TO D
					Woodland Kv= 5.0 lps
14.7	260	Total			

Subcatchment 1P: DA#1P



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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 2P: DA#2P

Runoff = 13.36 cfs @ 12.53 hrs. Volume= 1,881 af, Depth= 3.45"

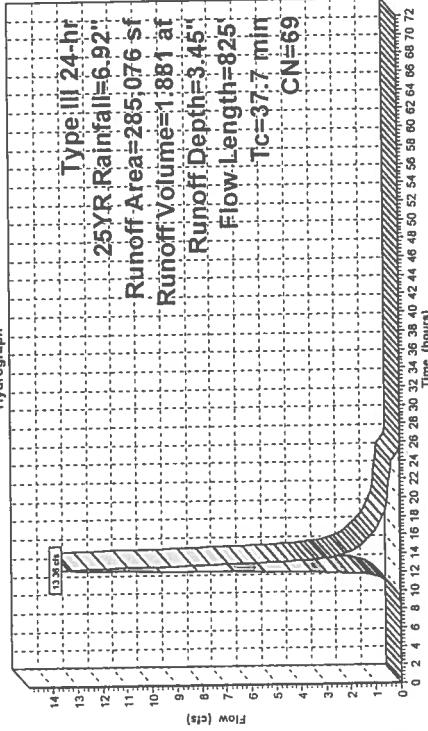
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
26,152	98	Paved parking & roofs
157,623	61	>75% Grass cover, Good, HSG B
101,301	73	Woods/grass comb., Poor, HSG B
285,076	69	Weighted Average
258,924		90.83% Pervious Area
26,152		9.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n= 0.800 P2= 3.20"	
7.1	600	0.0400	1.40	Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Short Grass Pasture Kv= 7.0 fps	
2.3	175	0.0620	1.24	Shallow Concentrated Flow, TRAVEL PATH D TO E	
				Woodland Kv= 5.0 fps	
37.7	825	Total			

Subcatchment 2P: DA#2P

Hydrograph



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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 3P: DA#3P

Runoff = 51.18 cfs @ 12.46 hrs, Volume= 6,719 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
127,629	98	Paved parking & roofs
519,577	61	>75% Grass cover, Good, HSG B
633,417	55	Woods, Good, HSG B
1,280,623	62	Weighted Average
1,152,994		90.03% Pervious Area
127,629		9.97% Impervious Area

31.2 2,050 Total

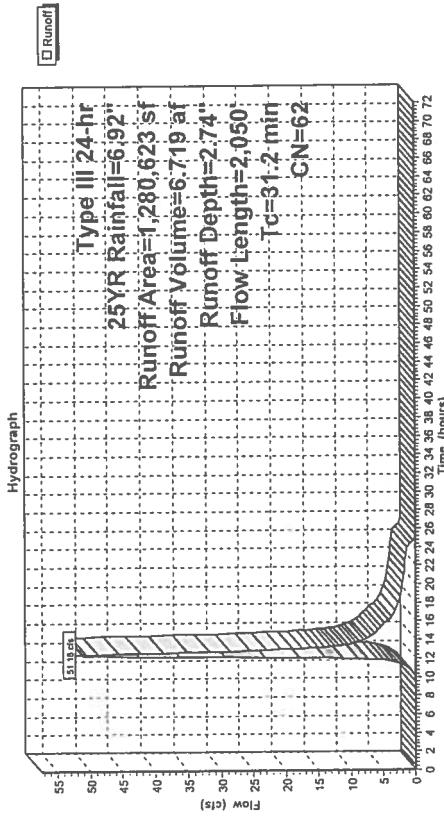
Type III 24-hr 25YR Rainfall=6.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

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Type III 24-hr 25YR Rainfall=6.92"
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Subcatchment 3P: DA#3P



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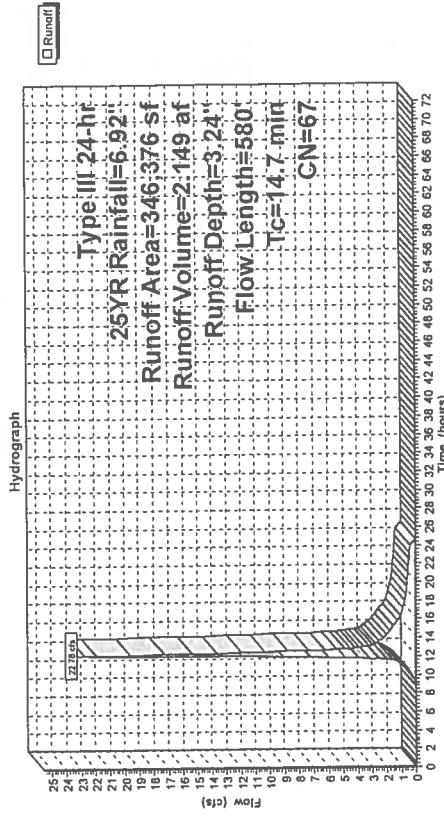
Type III 24-hr 25YR Rainfall=6.92"
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Summary for Subcatchment 4P: DA#4P

Runoff = 22.78 cfs @ 12.21 hrs, Volume= 2.149 af, Depth= 3.24"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25YR Rainfall=6.92"

Area (sf)	CN	Description
15,358	98	Paved parking & roofs
48,009	61	>75% Grass cover, Good, HSG B
283,009	66	Woods, Poor, HSG B
346,376	67	Weighted Average
331,018	95.57%	Pervious Area
15,358	4.43%	Impervious Area
Tc		
Length (feet)	Slope (ft/ft)	Velocity (ft/sec)
5.1	0.0250	0.16
0.3	0.0750	4.41
9.3	0.0260	0.81
Capacity		
(min)	(cfs)	(cfs)
14.7	580	Total

Subcatchment 4P: DA#4P



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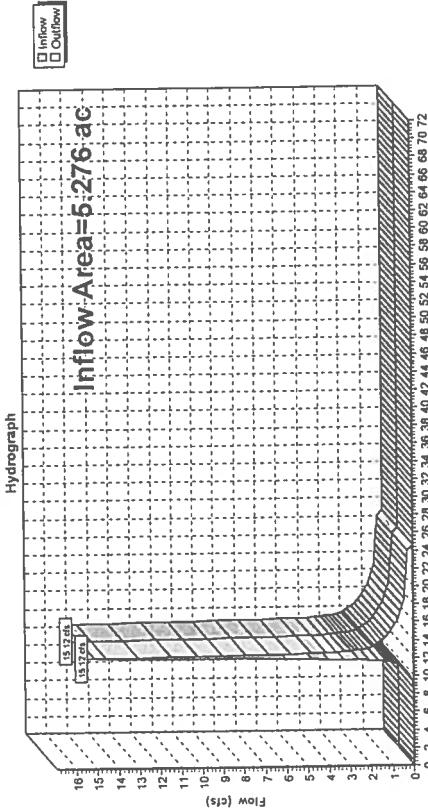
Type III 24-hr 25YR Rainfall=6.92"
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Summary for Reach IP#1: VERNAL POOL

Inflow Area = 5.276 ac, 5.30% Impervious, Inflow Depth = 3.24" for 25YR event
Inflow = 15.12 cfs @ 12.21 hrs, Volume= 1.426 af
Outflow = 15.12 cfs @ 12.21 hrs, Volume= 1.426 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL



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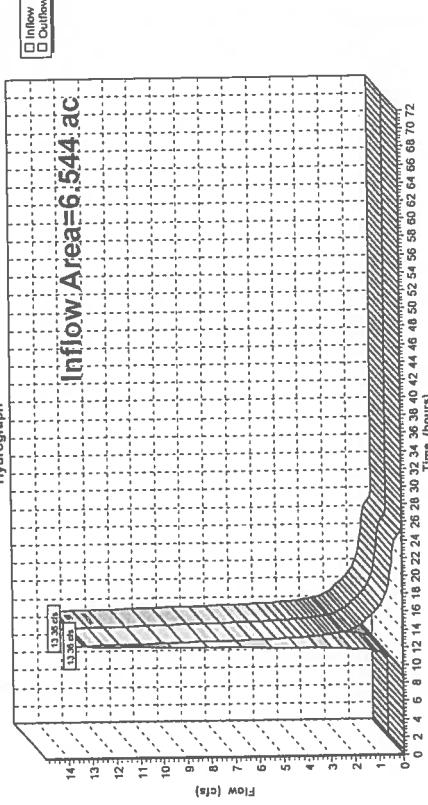
Type III 24-hr 25YR Rainfall=6.92"
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Summary for Reach IP#2: PROP LINE

Inflow Area = 6.544 ac, 9.17% Impervious, Inflow Depth = 3.45" for 25YR event
Inflow = 13.36 cfs @ 12.53 hrs, Volume= 1.881 af
Outflow = 13.36 cfs @ 12.53 hrs, Volume= 1.881 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE



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Summary for Reach IP#3: WETLANDS

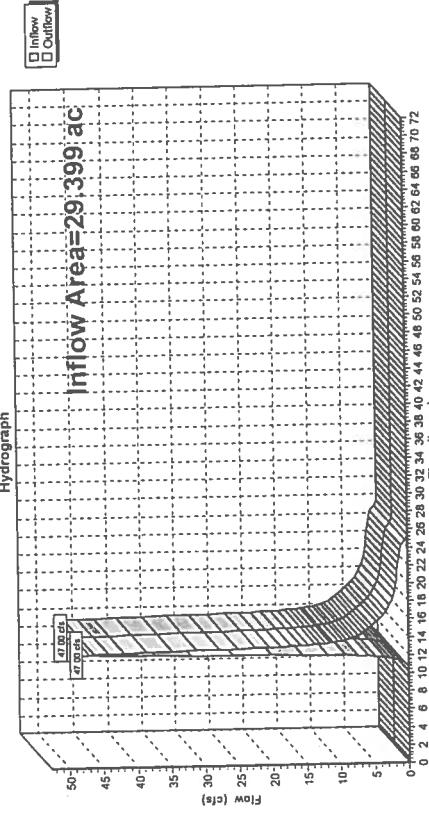
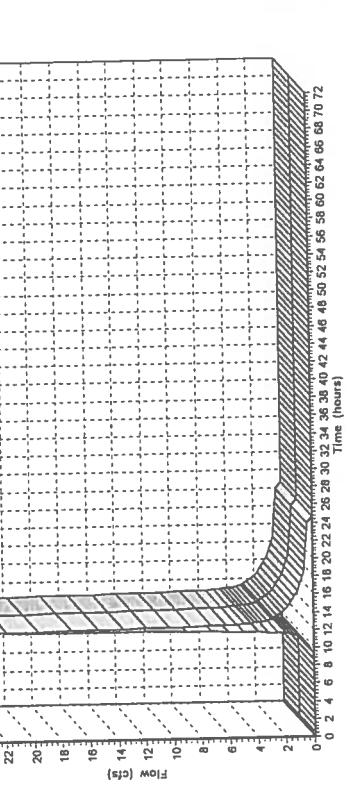
Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 2.60" for 25YR event
Inflow = 47.00 cfs @ 12.57 hrs, Volume= 6.378 af
Outflow = 47.00 cfs @ 12.57 hrs, Volume= 6.378 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS

Reach IP#4: PROP. LINE

Reach IP#4: PROP. LINE



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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 3.24" for 25YR event
Inflow = 22.78 cfs @ 12.21 hrs, Volume= 2.149 af
Outflow = 22.78 cfs @ 12.21 hrs, Volume= 2.149 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Type III 24-hr 25YR Rainfall=6.92"
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Summary for Pond 5P: BASIN#1

Inflow Area =	29.399 ac,	9.97% Impervious, Inflow Depth =	2.74"	for 25YR event
Inflow =	51.18 cfs @	12.46 hrs, Volume=	6.719 af	
Outflow =	47.48 cfs @	12.57 hrs, Volume=	6.719 af, Atten=7%, Lag= 6.9 min	
Discarded =	0.48 cfs @	12.57 hrs, Volume=	0.341 af	
Primary =	47.00 cfs @	12.57 hrs, Volume=	6.378 af	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 377.17' @ 12.57 hrs Surf.Area= 8.567 sf Storage= 18,766 cf

Plug-Flow detention time=10.5 min calculated for 6.719 af (100% of inflow)
 Center-of-Mass det. time=10.4 min (883.2 - 872.8)

Volume	Invert	Avail.Storage	Storage Description	Custom Stage Data (Prismatic) Listed below (Recalc)
#1	374.00'	64,442 cf		

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	4,200	0	0
376.00	6,050	10,250	10,250
378.00	10,371	16,421	26,671
380.00	13,000	23,371	50,042
381.00	15,800	14,400	64,442

Device Routing Invert Outlet Devices

#1 Primary	374.00'	36.0" Vert. Orifice/Grate	C = 0.500
#2 Discarded	374.00'	2.410 in/hr Exfiltration over Surface area	
#3 Primary	379.50'	35.0' long x 1.0' breadth Broad-Crested Rectangular Weir	

Head (feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
2.50	3.00									
Coef. (English)	2.69	2.72	2.75	2.85	2.98	3.08	3.20	3.28	3.31	3.31

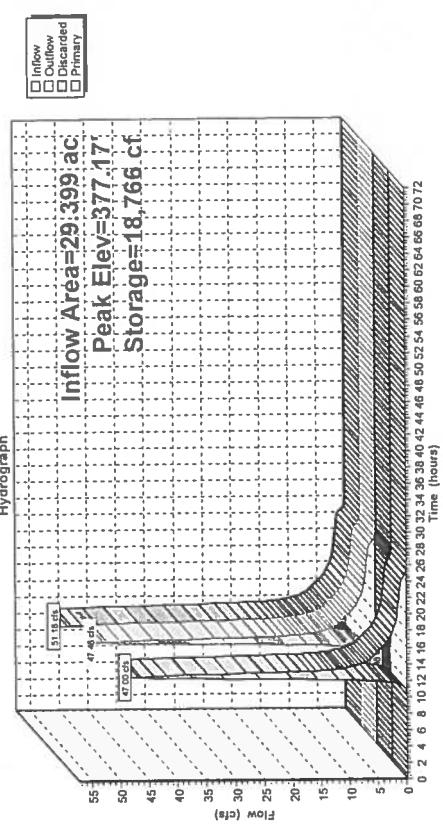
#4 Primary	376.00'	12.0" Vert. Orifice/Grate	C = 0.600
#5 Primary	377.50'	18.0" Vert. Orifice/Grate	C = 0.600

Discarded Outflow Max=0.48 cfs @ 12.57 hrs HW=377.16' (Free Discharge)

↓
 ↓=Exfiltration (Exfiltration Controls 0.48 cfs)

Primary Outflow Max=46.89 cfs @ 12.57 hrs HW=377.16' (Free Discharge)

↑
 ↑=Orifice/Grate (Orifice Controls 43.82 cfs @ 6.20 ps)
 ↓=Broad-Crested Rectangular Weir Controls 0.00 cfs
 ↓=Orifice/Grate (Orifice Controls 3.07 cfs @ 3.90 ps)
 ↓=Orifice/Grate (Controls 0.00 cfs)



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Type III 24-hr 50YR Rainfall=8.62"

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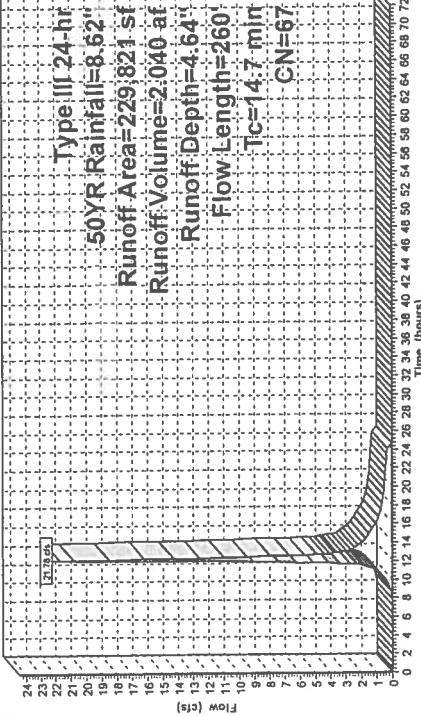
Summary for Subcatchment 1P: DA#1P

Runoff = 21.78 cfs @ 12.21 hrs, Volume=

2.040 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50YR Rainfall=8.62"

Tc	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	50	0.0200	0.07	Sheet Flow, TRAVEL PATH A TO B Grass: Bermuda n= 0.410 P2= 3.20"	
0.5	70	0.1000	2.21	Shallow Concentrated Flow, TRAVEL PATH B TO C Short Grass Pasture Kv= 7.0 fps	
1.6	140	0.0900	1.50	Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 fps	
14.7	260	Total			

Subcatchment 1P: DA#1P**Hydrograph****post development 8-24-16**

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Type III 24-hr 50YR Rainfall=8.62"

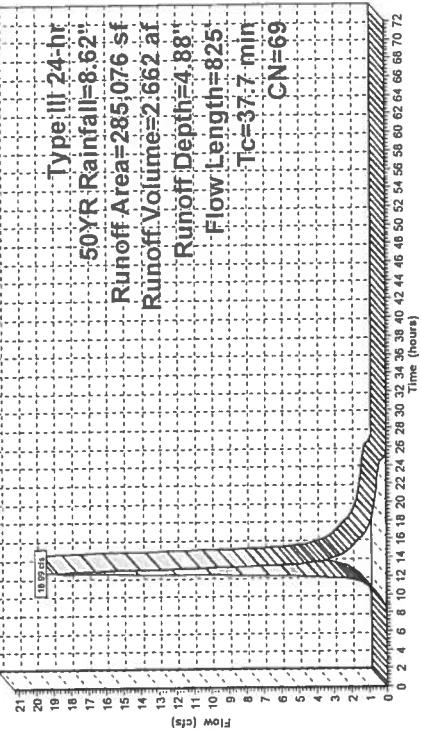
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Summary for Subcatchment 2P: DA#2P

Runoff = 18.99 cfs @ 12.52 hrs, Volume=

2.662 af, Depth= 4.88"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50YR Rainfall=8.62"

Area (sf)	CN	Description
12.172	98	Paved parking & roofs
38.295	61	>75% Grass cover, Good, HSG B
179.354	66	Woods, Poor, HSG B
229.821	67	Weighted Average
217.649		94.70% Perious Area
12.172		5.30% Impervious Area
37.7	825	Total

Subcatchment 2P: DA#2P**Hydrograph**

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Type III 24-hr 50YR Rainfall=8.62"
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Summary for Subcatchment 3P: DA#3P

Runoff = 76.73 cfs @ 12.45 hrs, Volume= 9.905 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR Rainfall=8.62"

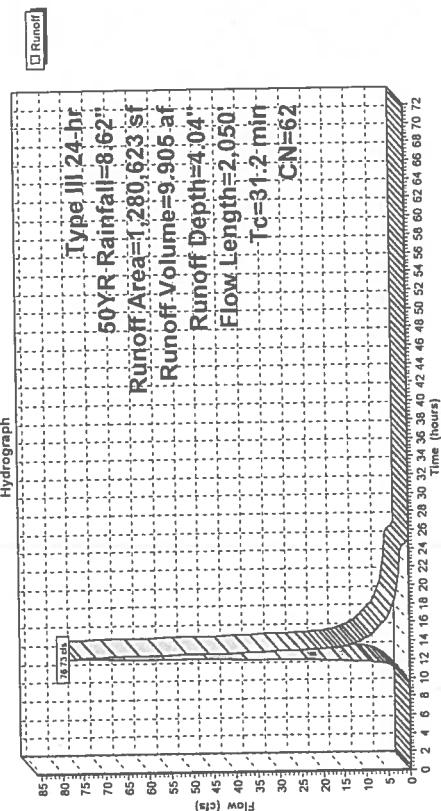
Area (sf)	CN	Description	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
127,629	98	Paved parking & roofs	28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
519,577	61	>75% Grass cover, Good, HSG B	0.4	100	0.0600	3.94	Woods, Dense underbrush n= 0.800 P2= 3.20"	
633,417	55	Woods, Good, HSG B	0.7	200	0.0500	4.54	Shallow Concentrated Flow, TRAVEL PATH B TO C	
1,280,623	62	Weighted Average	1.8	1,700	0.0500	15.71	Unpaved Kv= 16.1 fps	
1,152,994	94	90.03% Pervious Area					Shallow Concentrated Flow, TRAVEL PATH C TO D	
127,629	94	9.97% Impervious Area					Paved Kv= 20.3 ips	

31.2 2.050 Total

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Type III 24-hr 50YR Rainfall=8.62"
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Subcatchment 3P: DA#3P



Time (hours)

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Type III 24-hr 50YR Rainfall=8.62"
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Summary for Subcatchment 4P: DA#4P

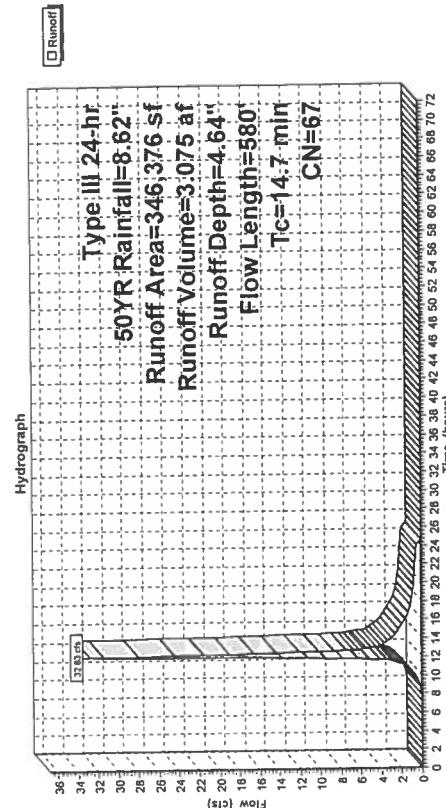
Runoff = 32.83 cfs @ 12.21 hrs, Volume= 3.075 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 50YR Rainfall=8.62"

Area (sf) CN Description

Area (sf)	CN	Description			
15,358	98	Paved parking & roofs			
48,009	61	>75% Grass cover, Good, HSG B			
283,009	66	Woods, Poor, HSG B			
346,376	67	Weighted Average			
331,018		95.57% Pervious Area			
15,358		4.43% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
5.1	50	0.0250	0.16		Sheet Flow, TRAVEL PATH A TO B
					Shallow Concentrated Flow, TRAVEL PATH B TO C
0.3	80	0.0750	4.41		Unpaved Kv= 16.1 fps
9.3	450	0.0260	0.81		Shallow Concentrated Flow, TRAVEL PATH C TO D
					Woodland Kv= 5.0 fps
14.7	580	Total			

Subcatchment 4P: DA#4P



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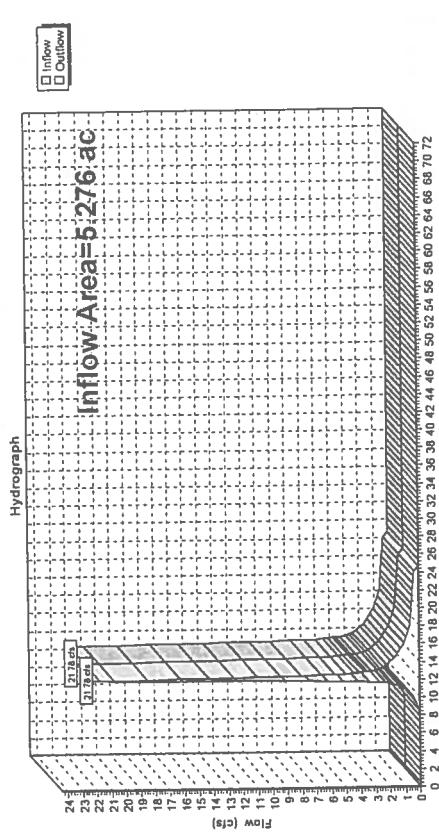
Type III 24-hr 50YR Rainfall=8.62"
 Printed 9/13/2016
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Summary for Reach IP#1: VERNAL POOL

Inflow Area = 5.276 ac, 5.30% Impervious, Inflow Depth = 4.64" for 50YR event
 Inflow = 21.78 cfs @ 12.21 hrs, Volume= 2.040 af
 Outflow = 21.78 cfs @ 12.21 hrs, Volume= 2.040 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL



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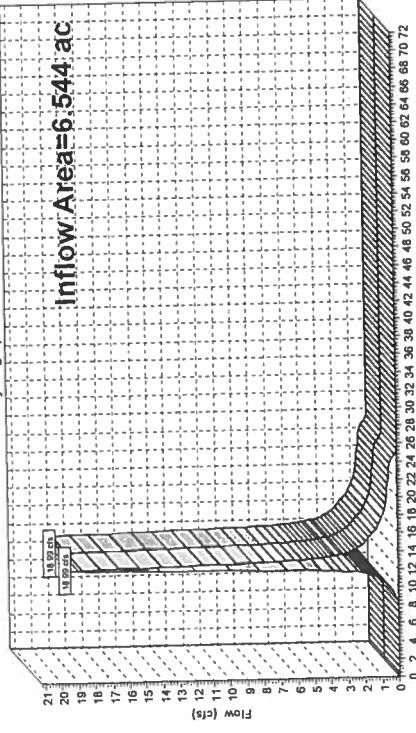
Summary for Reach IP#2: PROP LINE

Inflow Area = 6.544 ac, 9.17% Impervious, Inflow Depth = 4.88" for 50YR event
Inflow = 18.99 cfs @ 12.52 hrs, Volume= 2.662 af
Outflow = 18.99 cfs @ 12.52 hrs, Volume= 2.662 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE

Hydrograph



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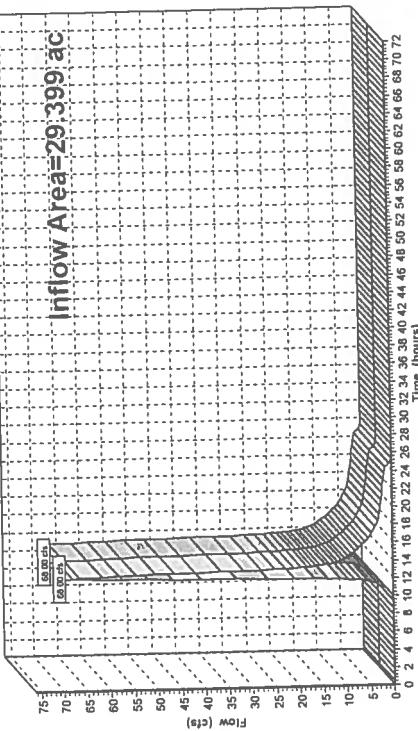
Summary for Reach IP#3: WETLANDS

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 3.89" for 50YR event
Inflow = 68.00 cfs @ 12.59 hrs, Volume= 9.528 af
Outflow = 68.00 cfs @ 12.59 hrs, Volume= 9.528 af, Attenu= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS

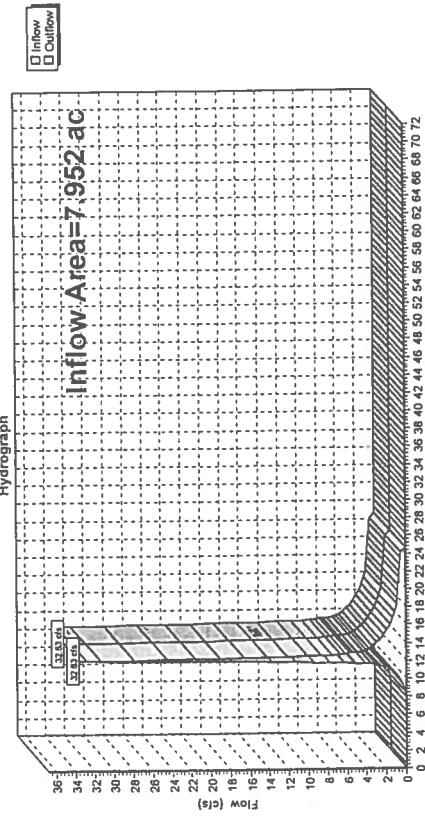
Hydrograph



post development 8-24-16Prepared by {enter your company name here}
HydroCAD® 10.00-16 s/n 01433 © 2015 HydroCAD Software Solutions LLCType III 24-hr 50YR Rainfall=8.62"
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Page 45**Summary for Reach IP#4: PROP. LINE**

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 4.64" for 50YR event
 Inflow = 32.83 cfs @ 12.21 hrs, Volume= 3.075 af
 Outflow = 32.83 cfs @ 12.21 hrs, Volume= 3.075 af, Attent= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#4: PROP. LINE**Hydrograph****post developmentmen 8-24-16**Prepared by {enter your company name here}
HydroCAD® 10.00-16 s/n 01433 © 2015 HydroCAD Software Solutions LLCType III 24-hr 50YR Rainfall=8.62"
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Page 46**Summary for Pond 5P: BASIN#1**

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 4.04" for 50YR event
 Inflow = 76.73 cfs @ 12.45 hrs, Volume= 9.905 af
 Outflow = 68.61 cfs @ 12.59 hrs, Volume= 9.905 af, Attent= 11%, Lag= 8.5 min
 Discarded = 0.61 cfs @ 12.59 hrs, Volume= 0.377 af
 Primary = 68.00 cfs @ 12.59 hrs, Volume= 9.528 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 378.47' @ 12.59 hrs Surf.Area= 10,988 sf Storage= 31,681 cf

Plug-Flow detention time=9.8 min calculated for 9.905 af (100% of inflow)
 Center-of-Mass det. time=9.7 min (87.1 - 86.1.4)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	64,442 cf	Custom Stage Data (Prismatic) listed below (Recalc)

Elevation (feet)	Surf Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	4,200	0	0
376.00	6,050	10,250	10,250
378.00	10,371	16,421	26,671
380.00	13,000	23,371	50,042
381.00	15,800	14,400	64,442

Device	Routing	Invert	Outlet Devices
#1	Primary	374.00'	36.0" Vert. Orifice/Grate C= 0.600
	Discarded	374.00'	2.410 in/hr Exfiltration over Surface area
#3	Primary	379.50'	35.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00

Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31
 #4 Primary 376.00' 12.0" Vert. Orifice/Grate C= 0.600
 #5 Primary 377.50' 18.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.61 cfs @ 12.59 hrs HW=378.46' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.61 cfs)

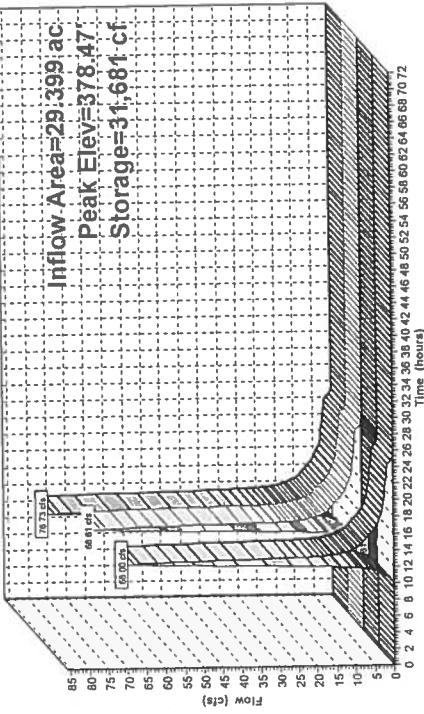
Primary OutFlow Max=67.89 cfs @ 12.59 hrs HW=378.46' (Free Discharge)
 1=Orifice/Grate (Orifice Controls 58.58 cfs @ 8.29 fps)
 3=Broad-Crested Rectangular Weir(Controls 0.00 cfs)
 4=Orifice/Grate (Orifice Controls 5.30 cfs @ 6.75 fps)
 5=Orifice/Grate (Orifice Controls 4.00 cfs @ 3.34 fps)

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Pond 5P: BASIN#1

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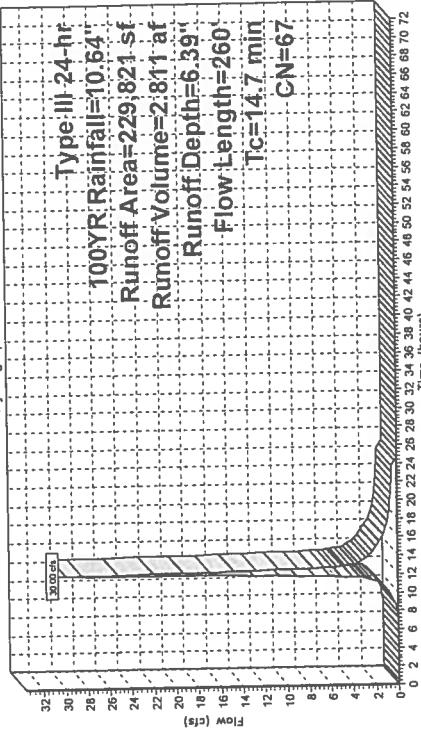
Summary for Subcatchment 1P: DA#1P

Runoff = 30.00 cfs @ 12.20 hrs. Volume= 2.811 af, Depth= 6.3g"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=10.64"

Area (sf)	CN	Description			
12,172	98	Paved parking & roofs			
38,295	61	>75% Grass cover, Good, HSG B			
179,354	66	Woods, Poor, HSG B			
229,821	67	Weighted Average			
217,649	58	94.70% Pervious Area			
12,172	50	5.30% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
12.6	50	0.0200	0.07		Sheet Flow, TRAVEL PATH A TO B
					Grass: Bermuda n= 0.410 P2= 3.20"
0.5	70	0.1000	2.21		Shallow Concentrated Flow, TRAVEL PATH B TO C
1.6	140	0.0900	1.50		Short Grass/Pasture Kv= 7.0 ips
					Shallow Concentrated Flow, TRAVEL PATH C TO D
					Woodland Kv= 5.0 ips
14.7	260	Total			

Subcatchment 1P: DA#1P



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Summary for Subcatchment 2P: DA#2P

Runoff = 25.88 cfs @ 12.52 hrs, Volume=

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=10.64"

Area (sf)	CN	Description
26,152	98	Paved parking & roofs
157,623	61	>75% Grass cover, Good, HSG B
101,301	73	Woods/grass comb., Poor, HSG B
285,076	69	Weighted Average
258,924	90	83% Pervious Area
26,152	9	17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	50	0.0100	0.03	Sheet Flow, TRAVEL PATH A TO B	
				Woods: Dense underbrush n= 0.800 P2= 3.20"	
7.1	600	0.0400	1.40	Shallow Concentrated Flow, TRAVEL PATH C TO D	
				Short Grass Pasture Kv= 7.0 fps	
2.3	175	0.0620	1.24	Shallow Concentrated Flow, TRAVEL PATH D TO E	
				Woodland Kv= 5.0 fps	
37.7	825	Total			

Subcatchment 2P: DA#2P

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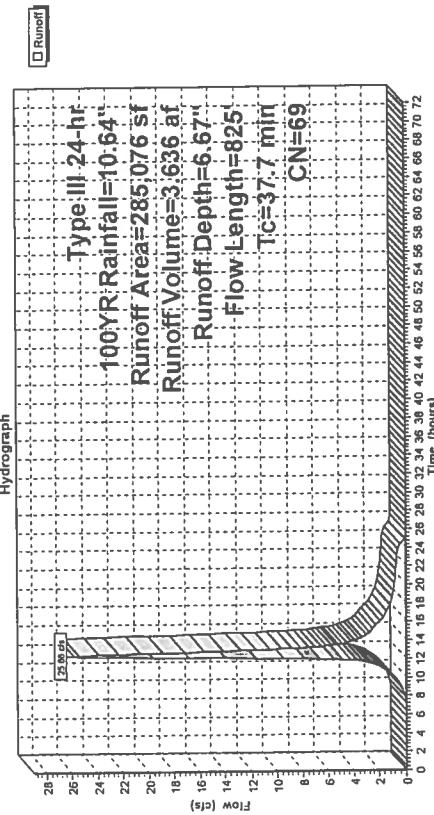
Summary for Subcatchment 3P: DA#3P

Runoff = 108.92 cfs @ 12.44 hrs, Volume=

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=10.64"

Area (sf)	CN	Description
127,629	98	Paved parking & roofs
519,577	61	>75% Grass cover, Good, HSG B
633,417	55	Woods, Good, HSG B
1,280,623	62	Weighted Average
1,152,994	90	0.93% Pervious Area
127,629	9	9.97% Impervious Area

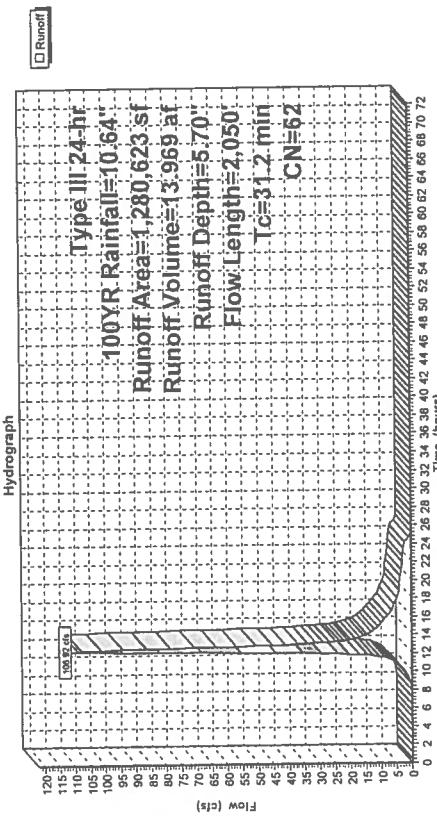
31.2 2,050 Total



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Subcatchment 3P: DA#3P



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Summary for Subcatchment 4P: DA#4P

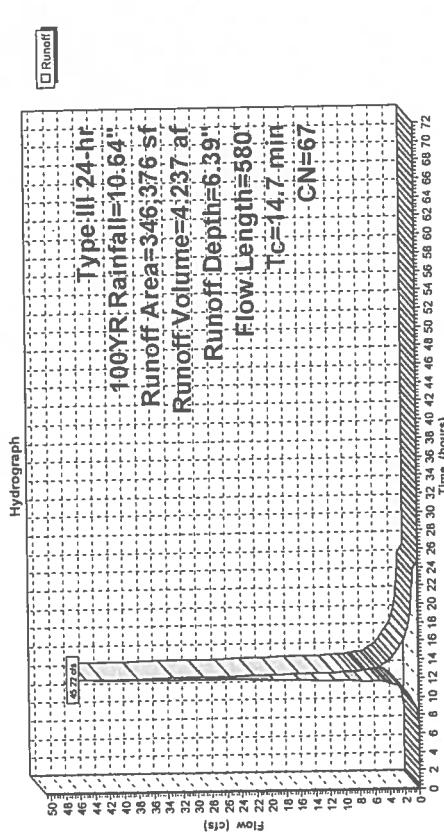
Runoff = 45.22 cfs @ 12.20 hrs, Volume= 4.237 af, Depth= 6.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100YR Rainfall=10.64"

Area (sf)	CN	Description			
15,358	98	Paved parking & roofs			
48,009	61	>75% Grass cover, Good, HSG B			
283,009	66	Woods, Poor, HSG B			
346,376	67	Weighted Average			
331,018		95.57% Perious Area			
15,358		4.43% Imperious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		Sheet Flow, TRAVEL PATH A TO B
0.3	80	0.0750	4.41		Grass: Short n= 0.150 P2= 3.20"
9.3	450	0.0260	0.81		Shallow Concentrated Flow, TRAVEL PATH B TO C Unpaved Kv= 16.1 ips
					Shallow Concentrated Flow, TRAVEL PATH C TO D Woodland Kv= 5.0 ips

14.7 580 Total

Subcatchment 4P: DA#4P



Time (hours)

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Summary for Reach IP#1: VERNAL POOL

Inflow Area = 5.276 ac, 5.30% Impervious, Inflow Depth = 6.39" for 100YR event
 Inflow = 30.00 cfs @ 12.20 hrs, Volume= 2.811 af
 Outflow = 30.00 cfs @ 12.20 hrs, Volume= 2.811 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#1: VERNAL POOL



Summary for Reach IP#2: PROP LINE

Inflow Area = 6.544 ac, 9.17% Impervious, Inflow Depth = 6.67" for 100YR event
 Inflow = 25.88 cfs @ 12.52 hrs, Volume= 3.636 af
 Outflow = 25.88 cfs @ 12.52 hrs, Volume= 3.636 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#2: PROP LINE

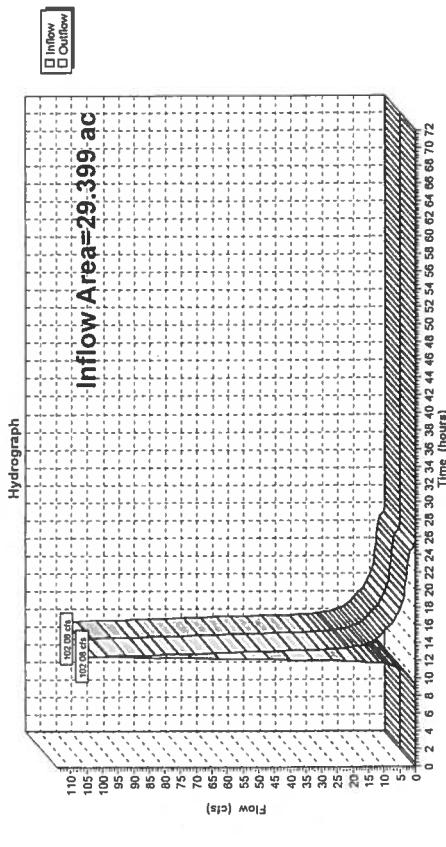


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Summary for Reach IP#3: WETLANDS

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 5.53" for 100YR event
 Inflow = 102.08 cfs @ 12.55 hrs, Volume= 13.555 af
 Outflow = 102.08 cfs @ 12.55 hrs, Volume= 13.555 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#3: WETLANDS

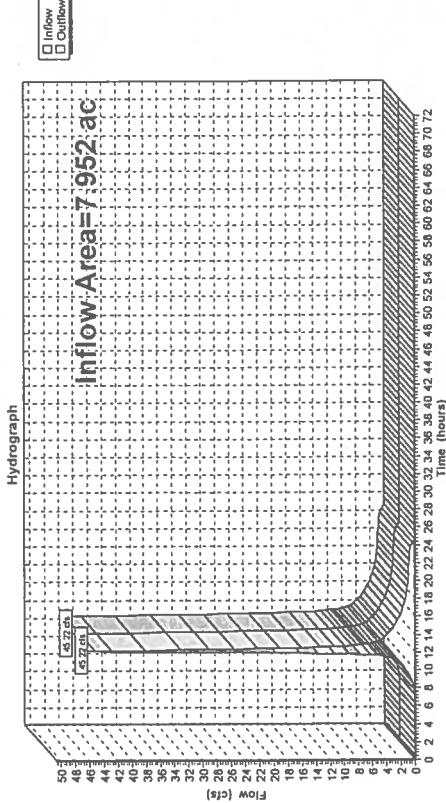


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Summary for Reach IP#4: PROP. LINE

Inflow Area = 7.952 ac, 4.43% Impervious, Inflow Depth = 6.39" for 100YR event
 Inflow = 45.22 cfs @ 12.20 hrs, Volume= 4.237 af
 Outflow = 45.22 cfs @ 12.20 hrs, Volume= 4.237 af, Atten= 0%, Lag= 0.0 min
 Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach IP#4: PROP. LINE



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Type III 24-hr 100YR Rainfall=10.64"

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Type III 24-hr 100YR Rainfall=10.64"
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Summary for Pond 5P: BASIN#1

Inflow Area = 29.399 ac, 9.97% Impervious, Inflow Depth = 5.70" for 100YR event
 Inflow = 108.92 cfs @ 12.44 hrs, Volume= 13.969 af, Attenu= 6%, Lag= 6.6 min
 Outflow = 102.79 cfs @ 12.55 hrs, Volume= 13.969 af, Discarded = 0.71 cfs @ 12.55 hrs, Volume= 0.414 af
 Primary = 102.08 cfs @ 12.55 hrs, Volume= 13.555 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 379.78' @ 12.55 hrs Surf.Area= 12,714 sf Storage= 47,242 cf

Plug-Flow detention time= 9.3 min calculated for 13.960 af (100% of inflow)
 Center-of-Mass det. time= 9.3 min (860.7 - 851.4.)

Volume	Invert	Avail.Storage	Storage Description
#1	374.00'	64,442 cf	Custom Stage Data (Prismatic) listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
374.00	4,200	0	0
376.00	6,050	10,250	10,250
378.00	10,371	16,421	26,671
380.00	13,000	23,371	50,042
381.00	15,800	14,400	64,442

Device Routing Invert Outlet Devices

#1	Primary	374.00'	36.0' Vert. Orifice/Grate C= 0.600
#2	Discarded	374.00'	2.410 in/hr Exfiltration over Surface area
#3	Primary	379.50'	35.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00

			2.50 3.00
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31
			3.30 3.31 3.32

#4	Primary	376.00'	12.0' Vert. Orifice/Grate C= 0.600
#5	Primary	377.50'	18.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.71 cfs @ 12.55 hrs HW=379.78' (Free Discharge)
 ↓ 2=Exfiltration (Exfiltration Controls 0.71 cfs)

Primary OutFlow Max=101.97 cfs @ 12.55 hrs HW=379.78' (Free Discharge)

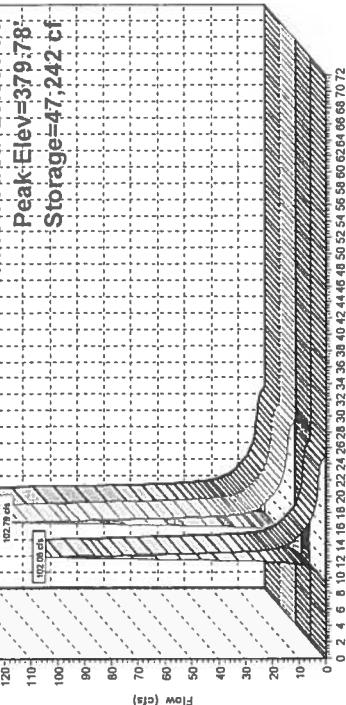
↓ 1=Orifice/Grate (Orifice Controls 70.43 cfs @ 9.96 fps)

↓ 3=Broad-Crested Rectangular Weir (Weir Controls 14.16 cfs @ 1.43 fps)

↓ 4=Orifice/Grate (Orifice Controls 6.85 cfs @ 8.72 fps)

↓ 5=Orifice/Grate (Orifice Controls 10.53 cfs @ 5.96 fps)

Pond 5P: BASIN#1



Type III 24-hr 100YR Rainfall=10.64"
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Stormwater Report
“Village At Institute Road”
Grafton, MA

Date: September 13, 2016

Prepared For:
D&F Afonso Builder Corp.
189 Main Street
Milford, Ma 01757

Prepared By:
Guerriere & Halnon, Inc.
333 West street
Milford, MA 01757
G&H Project G-9411

Narrative:

The project proponent proposes to construct a 46 lot residential development. This development is known as "The Village At Institute Road" and consists of 46 single family homes serviced by public water and sewer and driveway as shown conceptual on the Definitive Plans. The development also includes construction of three 26' wide paved roadways as shown on the plans. The proposed drainage system will consist of catch basins and drain manholes along the proposed roadways and directed to a forebay and infiltration basin.

The itemized report that follows will document design compliance with the Massachusetts Stormwater Management Standards 1-10.

8/17/16

Date



Peter M. Lavoie

Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Proposed – All road drainage is being collected and treated at the proposed basin. The new outfall discharges, treated stormwater in compliance with Standards 4 through 6. Evaluated at a 100-year 24-hour storm event, the peak velocity of any the new outfall is non-erosive to proposed receiving surface.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

To meet Standard 2, the post-development peak discharge rate must be equal to or less than pre-development rates to prevent storm damage and downstream flooding from the 2-year and the 10-year 24-hour storm events.

Peak discharge rates were calculated and evaluated at four locations for this project. The point of evaluation is shown on the accompanying drainage plans designated as “IP#1(vernal pool), IP#2(Property Line - West), IP#3 Wetlands Northwest corner) and IP#4(Property Line - North) “respectively for the pre-development conditions and post-development conditions.

In summary of the detailed calculations attached, the peak discharge rates in cubic feet per second (cfs) Please refer to the Existing & Proposed Conditions Table.

Standard 3: Loss of annual recharge to ground water shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.60 inches of runoff
C	0.25 inches of runoff
B	0.35 inches of runoff
D	0.10 inches of runoff

Soils underlying the site are defined as hydrologic group “A” * (*USDA/NRCS Soil Survey of Middlesex County). From soil testing and soil texture performed in field the soil classification is B.

The required volume of recharge for post-development conditions is calculated as follows;

Total impervious area = 1,811,296 s.f.(0.35 inches/12 inches) = 52,829 c.f.

The volume of recharge provided for post-development conditions is as follows;

BMP utilized – Infiltration Basins

Recharge Basin 1	
Bottom of basin elevation	474.00
Overflow elevation	481.00
Total storage/recharge height	7.0
Total storage/recharge volume	64,442 cf
(see recharge storage table)	

Total Recharge Volume Provided 64,442 cf

Soils

Field investigations of the soils reveal the following soil profiled for the basins:

See Soil logs.

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- a) *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
- b) *Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and*
- c) *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The required Water Quality Volume, the runoff volume requiring 80% TSS removal, is calculated as follows:

Refer to the TSS worksheets.

Standard 4 requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan.

The long-term pollution prevention plan is incorporated into the Operation and Maintenance Plan required by Standard 9.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not a use with higher potential pollutant loads.

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The subject property does discharge storm water within the Zone II or Interim Wellhead Protection Area of a public water supply or to any other critical area. Pretreatment has been added to treat runoff prior to discharge into the proposed infiltration basins

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable:

It is not a redevelopment project.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

Standard 8, cont'd.

Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control.
EPA NPDES – Storm Water Pollution Prevention Plan (SWPPP)

A. Names of Persons or Entity Responsible for Plan Compliance

Owner/Applicant: D&F Afonso Builders Corp.
189 Main Street
Milford MA 01757

B. Construction Period Pollution Prevention Measures

1. Inventory materials to be present on site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers and if possible under a roof or covered.
4. Follow manufacturer's recommendation for disposal of used containers.
5. Store only enough product on site to do the job.

6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.
 - b. Conduct all vehicle and equipment maintenance and refueling in front of building, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site, per Local and State regulations.
 - f. Maintain a clean construction entrance where truck traffic is frequent to reduce soil compaction constant sweeping is required and limit tracking of sediment into streets, sweeping street when silt is observed on street.
7. Stock pile materials, and maintain Erosion Control around the materials where it can easily be accessed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers.
8. Clean up spills.
 - a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - b. Sweep up dry materials immediately. Never wash them away or bury them.
 - c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil in a certified container and notify a certified hauler for removal.
 - d. Report significant spills to the Fire Department.
9. It is the responsibility of the site superintendent or employees designated by the Applicant to inspect erosion control and repair as needed, also to inspect all on site vehicles for leaks and check all containers on site that may contain hazardous materials daily.

C. Erosion and Sedimentation Control Plan:

1. See Erosion Control Plans.

D. Site Development Plans;

1. See Grading Plans.

E. Construction Plans

1. Construction Sequencing Plan
 - a. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules.
 - b. Install DEP File # Sign.
 - c. Prior to any work on the site including tree/brush clearing, the approved limit of clearing as well as the location of the proposed erosion control devices (such as silt fence/straw bales, etc.) must be staked on the ground under the direction of a Massachusetts registered Professional Land Surveyor.
 - d. Install silt fence/mulch sock at locations
 - e. Strip off top and subsoil. Stockpile material to be reused away from the wetland, remove excess material from the site. Install and maintain erosion control barrier around stockpile.
 - f. Rough grade site, maintaining a temporary low area/sediment trap away from the wetland.
 - g. Construct drainage outfalls and stilling basin. Stabilize side slopes with loam, seed and mulch.
 - h. Install underground utilities; protect all open drainage structures with erosion/siltation control devices.

- i. Install binder course of bituminous asphalt.
 - j. Install wearing course of asphalt, and striping (where required).
 - k. Maintain all erosion control devices until site is stabilized and a Certificate of Compliance is issued by the Conservation Commission.
 - l. The Contractor shall be responsible to schedule any required inspections of his/her work.
2. Construction Waste Management Plan
 - a. Dumpster for trash and bulk waste collection shall be provided separately for construction.
 - b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
 - c. Segregate and provide containers for disposal options for waste.
 - d. Do not bury waste and debris on site.
 - e. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
 - f. The sewer system is only for disposal of human waste, and substances permitted for disposal in the site sewer permit with the Town DPW.

F. Operation and Maintenance of Erosion and Sedimentation Controls

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the stormwater component shall be performed as noted below. The contractor shall have erosion control in place at all times. The contractor, based on future weather reports, shall prepare and inspect all erosion control devices; cleaning, repairing and upgrading is a priority so that the devices perform as per design. Inspect the site during rain events. Don't stay away from the site. At a minimum there should be inspection to assure the devices are not clogged or plugged, or that devices have not been destroyed or damaged during the rain event. After a storm event inspection is required to clean and repair any damage components. Immediate repair is required.

G. Inspection and Maintenance Schedules

1. Inspection must be conducted at least once every 7 days and within 24 hours of the end of a storm event 0.5 inches or greater.
2. Inspection frequency can be reduced to once a month if:
 - a. The site is temporarily stabilized.
 - b. Runoff is unlikely due to winter conditions, when site is covered with snow or ice.
3. Inspections must be conducted by qualified personnel, "qualified personnel" means a person knowledgeable in the principles and practice of erosion and sediment controls and who possess the skills to assess the conditions and take measures to maintain and ensure proper operation, also to conclude if the erosion control methods selected are effective.
4. For each inspection, the inspection report must include: (See attached inspection and maintenance log)
 - a. The inspection date.
 - b. Names, titles of personnel making the inspection.
 - c. Weather information for the period since the last inspection.
 - d. Weather information at the time of the inspection.
 - e. Locations of discharges of sediment from the site, if any.
 - f. Locations of BMP's that need to be maintained.
 - g. Locations where additional BMP's may be required.
 - h. Corrective action required or any changes to the SWPPP that may be necessary.

5. The owner, or their representative, such as the contractor, shall inspect the following in-place work;

Inspection Schedule:

Erosion Control	Weekly
Catch Basins & Drop Inlets	Weekly
Temporary Sedimentation Traps/Basins	Weekly
Street & Parking Area Sweeping	Daily

Please Note: Special inspections shall also be made after a significant rainfall event.

Maintenance Schedule

Erosion Control Devices Failure	Immediately
Catch Basins	Sump 1/4 full of sediment
Temporary Sedimentation Traps/Basins	As needed
Street Sweeping	14 days minimum and prior to any significant rain event.

Please Note: Special maintenance shall also be made after a significant rainfall event.

- H. Inspection and Maintenance Log Form. (Log Form Follows)

Standard 9: A Long –Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The following shall serve as the (O&M) Plan required by Standard 9, as well as the Long Term Pollution Prevention Plan required by Standard 4.

A. Names of Persons or Entity Responsible for Plan Compliance:

Owner/Applicant: Town of Grafton

B. Good housekeeping practices

1. Maintain site, landscaping and vegetation.
2. Sweep and pick up litter on pavements and grounds.
3. Deliveries shall be monitored by owners or representative to ensure that if any spillage occurs, it shall be contained and cleaned up immediately.
4. Maintain pavement and curbing in good repair.

C. Requirements for routine inspections and maintenance of stormwater BMPs

1. Plans: The stormwater Operation and Maintenance Plan shall consist of all Plans, documents and all local state and federal approvals as required for the subject property.
2. Record Keeping:
 - a. Maintain a log of all operation and maintenance activities for at least three years following construction, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location);
 - b. Make this log available to MassDEP and the Conservation Commission upon request; and
 - c. Allow MassDEP and the Conservation Commission to inspect each BMP to determine whether the responsible party is implementing the Operation and Maintenance Plan.
3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following;
 - a. Street Sweeping – Stipulated within the Construction Period Pollution Prevention Plan, the Long Term Pollution Prevention Plan, and the Operation and Maintenance Plan. As the amount of TSS removal is discretionary, no credit was taken within the calculations for this BMP.
 - b. Deep sump catch basins with hoods installed to promote TSS Removal of solids and control floatable pollutants. This BMP has a design rate of 25% TSS Removal.
 - c. Forebay TSS Removal of solids and control floatable pollutants This BMP has a design rate of 25% TSS Removal.
 - d. Infiltration basin to provide the required recharge as well as provide an additional 80% TSS Removal. Refer to TSS Removal Worksheet in Standard 4 for treatment train.
4. BMP Maintenance: After construction it is the responsibility of the owner to perform maintenance. The cleaning of the components of the stormwater management system shall generally be as follows:
 - a. Roadway & Parking Areas: The owner shall keep the roadway swept with a mechanical sweeper semi-annually at a minimum.
 - b. Catch Basins: Shall be cleaned by excavating, pumping or vacuuming. The sediment shall be disposed of off-site by the Owner. Inspect quarterly, remove silt when ¼ full.
 - c. Infiltration Basins: Inspect twice per year and after every major event for the first few months. Clean sediment out of isolator row in basins 2 times per year.

- d. Settling Basins & Forebay: Mow basins at least twice per year. Clean sediment out of basins 2 times per year.
 - 5. Access Provisions: All of the components of the storm water system will be accessible by the Owner
- D. Spill prevention and response plans
- 1. Inventory materials to be present on site during construction.
 - 2. Train employees and subcontractors in prevention and clean up procedures.
 - 3. All materials stored on site will be stored in their appropriate containers under a roof.
 - 4. Follow manufacturers recommendation for disposal of used containers.
 - 5. Store only enough product on site to do the job.
 - 6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.
 - b. Conduct all vehicle and equipment maintenance and refueling in one location, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site.
 - 7. Clean up spills.
 - a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - b. Sweep up dry materials immediately. Never wash them away or bury them.
 - c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
 - d. Report significant spills to the Fire Department, Conservation Commission and Board of Health.
- E. Provisions for maintenance of lawns, gardens, and other landscaped areas
Use only organic fertilizer. Dispose of clippings outside of the 100 foot buffer zone to the adjacent wetland.
- F. Requirements for storage and use of herbicides, and pesticides
The application of herbicides or pesticides will be done by professional certified contractor.
- G. Provisions for operation and management of septic system
The system shall be inspected and maintained according to the schedule noted on the approved Board of Health plan.
- H. Provisions for solid waste management
- 1. Waste Management Plan
 - a. Dumpster for trash and bulk waste collection shall be stored inside or under a roof.
 - b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material is recommended.
 - c. Do not bury waste and debris on site.
 - d. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
- I. Snow disposal and plowing plans relative to Wetland Resource Areas

Snow storage is adequate around the site for small storm events. The owner will have to coordinate snow removal to off site location due to the developments size and location of wetlands.

- J. Winter Road Salt and/or Sand Use and Storage restrictions
No sand, salt, or chemicals for de-icing will be stored outside.

- K. Street and parking lot sweeping schedules
Sweeping, the act of cleaning pavement can be done by mechanical sweepers, vacuum sweeper or hand sweeper. The quantity of sand is a direct correlation with the treatment of ice and snow and the types of chemicals and spreaders that are being used on site to manage snow. If a liquid de-icer such as calcium chloride is used as a pretreatment to new events the amount of sand is minimized. Sweeping for this site should be done semi-annually at a minimum. Collecting the particulate before it enters the catch basins is cheaper and more environmentally friendly than in a catch basin mixing with oils and greases in the surface water runoff in catch basins.

- L. Provisions for prevention of illicit discharges to the stormwater management system
The discharge into the stormwater system is not being violated, see attachment for illicit discharges compliance.

- M. Training the staff or personnel involved with implementing Long-Term Pollution Prevention Plan
The owner shall develop policies and procedures for containing the illicit spilling of oils, soda, beer, paper and litter. These wastes provide a degrading of the water quality. The placement of signs and trash barrels with lids around the site would contribute to a clean water quality site conditions.

- N. List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:
Town of Grafton

Standard 10: All illicit discharges to the stormwater management system are prohibited.

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. The Illicit Discharge Compliance Statement may be filed with the Notice of Intent. If the Illicit Discharge Compliance Statement has not been filed, the Final Order of Conditions shall require the submission of an Illicit Discharge Compliance Statement prior to the start of construction. The issuing authority should not issue a Certificate of Compliance until it has determined that the Illicit Discharge Compliance Statement has been submitted, has reviewed the Illicit Discharge Compliance Statement, and has verified that there are no illicit discharges at the site.

(Illicit Discharge Compliance Statement Follows)

Attachment
Illicit Discharge Compliance Statement

It is the intent of the Applicant D&F Afonso Builders Corp. to control illicit disposal into the storm drainage system. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Applicant will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,

D&F Afonso Builders Corp

Supporting Calculations

STAGE-STORAGE WORKSHEET					
		GUERRIERE & HALNON, INC. ENGINEERING & LAND SURVEYING 333 WEST STREET, MILFORD, MASS 01757			
	DATE:	8/23/2016		CLIENT:	D&F
PROJECT NUMBER:	W2658		CALCULATED BY:		
BASIN NUMBER:	Recharge		CHECKED BY:		
LOCATION:	GRAFTON				
ELEVATION	AREA (FEET)	AVERAGE AREA (FT ²)	VERTICAL INTERVAL (FT)	VOLUME INCREMENTAL (FT ³)	VOLUME CUMULATIVE (FT ³)
474.0	4200				0
476.0	6050	5125	2	10250	10250
478	10371	8211	2	16421	26671
480	13000	11686	2	23371	50042
481.0	15800	14400	1	14400	64442

**WEEKLY
Inspection and Maintenance Log
DURING CONSTRUCTION**

FOR: W2658
& After 0.5" Rain

Components	Date
Erosion Control – Weekly Comments during insp.	
Note corrective measures performed & Date	
On Site Pavement Sweeping – as Needed Comments during insp.	
Note corrective measures performed & date	
Catch Basin with Silt Sack & Haybales – Monthly Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Institute Road Area as Needed Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Areas as Needed Comments during insp.	
Note corrective measures performed & date	<hr/> Inspector _____ Title _____ Date _____
	<hr/> Address _____ Tel# _____

**WEEKLY
Inspection and Maintenance Log
DURING CONSTRUCTION**

FOR: W2658
& After 0.5" Rain

Components	Date
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Silt of Public Streets – Daily	
Comments during insp.	
Note corrective measures performed & date	
Stockpile Materials Ring with Haybales – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical- Daily	
Comments during insp.	
Note corrective measures performed & date	
Temporary Ground Cover Area – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Stone at Access Drive as Needed	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
_____	Date _____

**WEEKLY
Inspection and Maintenance Log
DURING CONSTRUCTION**

FOR: W2658
& After 0.5" Rain

	Address	Tel#	
Components			Date
Lawn Area / Mulch Area			
Erosion, Washouts			
Comments during insp.			
Note corrective measures performed & date			
Stone Aprons at outlets as Needed			
Comments during insp.			
Note corrective measures performed & date			
Catch Basins as Needed			
Comments during insp.			
Note corrective measures performed & date			
Forebay Area as Needed			
Comments during insp.			
Note corrective measures performed & date			
Illicit Drainage Discharge			
Comments during insp.			
Note corrective measures performed & date			
	Inspector	Title	Date

**WEEKLY
Inspection and Maintenance Log
AFTER CONSTRUCTION**

FOR: w2658
& After 0.5" Rain

Components	Date
Forebay Area Basin#1 - twice a year	
Comments during insp.	
Note corrective measures performed & Date	
Drain Manholes prior to Forebay -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Catch Basins - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Basin outlet - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Inverts at Headwalls - twice a year	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
_____	Date _____
Address _____	Tel# _____

**WEEKLY
Inspection and Maintenance Log
AFTER CONSTRUCTION**

FOR: w2658
& After 0.5" Rain

Components	Date
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Illicit Drainage	
Discharge –	
Comments during insp.	
Note corrective measures performed & date	
Access to basin area	
- twice a year	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical- -as-needed	
Comments during insp.	
Note corrective measures performed & date	
Lawn Areas	
-Once a year	
Comments during insp.	
Note corrective measures performed & date	
Crush Stone Aprons at outlets	
-Twice a year and replenish stone as needed	
Comments during insp.	
Note corrective measures performed & date	
Inspector _____	Title _____
Date _____	

Version 1, Automated: Mar. 4, 2008

- INSTRUCTIONS:**
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
 2. Select BMP from Drop Down Menu
 3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: (Basin#1) 3P

B	C	D	E	F
BMP	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
Sediment Forebay	0.25	0.11	0.03	0.08
	0.00	0.08	0.00	0.08
Total TSS Removal =				92%
Separate Form Needs to be Completed for Each Outlet or BMP Train				

TSS Removal Worksheet

Project: W-2658

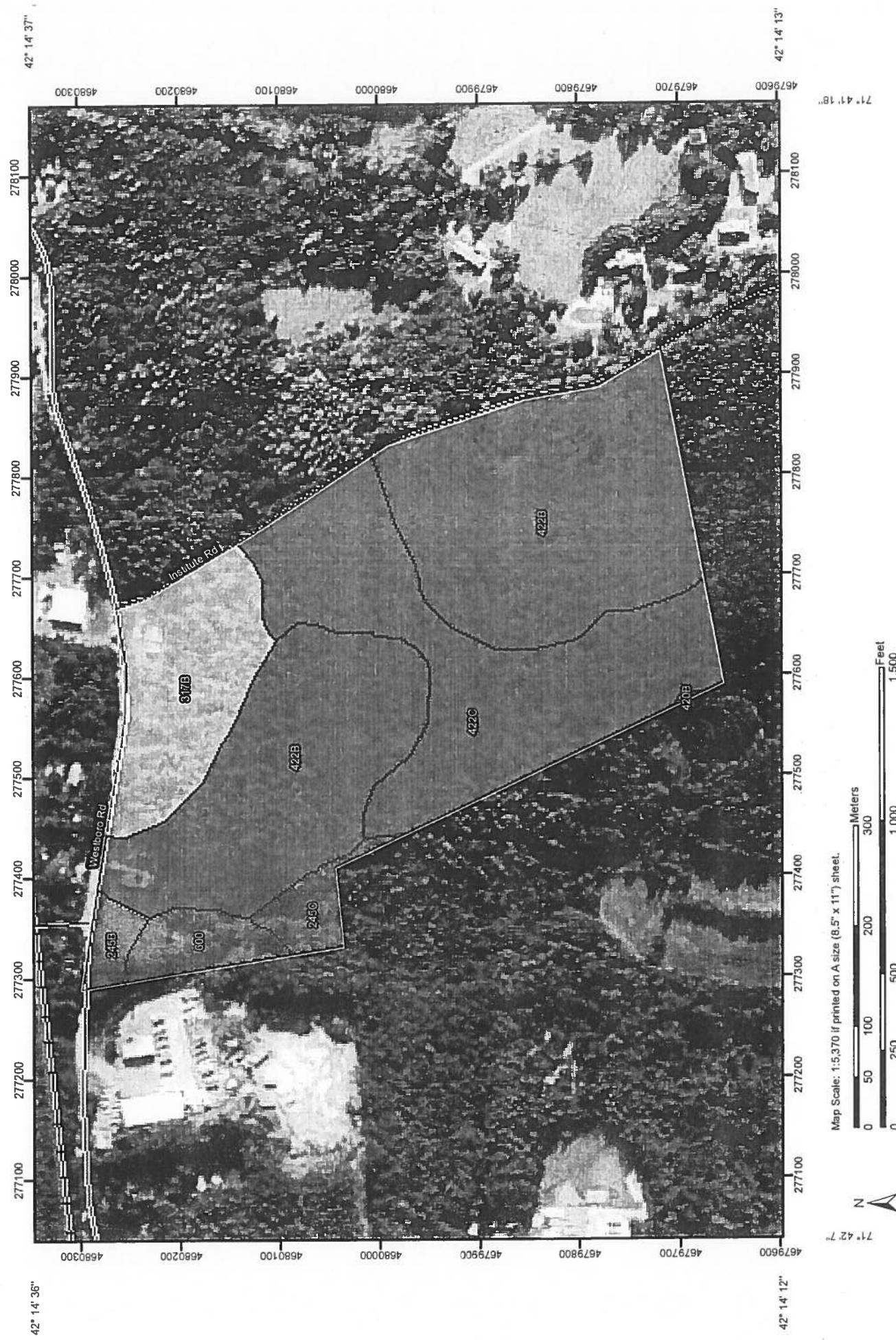
Prepared By: Peter M. Lawrie

Date: 23-Aug-16

*Equals remaining load from previous BMP (E)
which enters the BMP

Soil Information

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part



MAP LEGEND

Area of Interest (AOI)



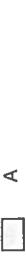
Area of Interest (AOI)

Soils



Soil Map Units

Soil Ratings



A



A/D



B



B/D



C



C/D



D

Not rated or not available

Political Features



Cities

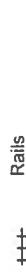
Water Features



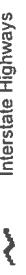
Oceans

Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

MAP INFORMATION

Map Scale: 1:5,370 if printed on A size (8.5" x 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:25,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 5, Jan 30, 2007

Date(s) aerial images were photographed: 8/19/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Worcester County, Massachusetts, Southern Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
245B	Hinckley sandy loam, 3 to 8 percent slopes	A	0.9	1.7%
245C	Hinckley sandy loam, 8 to 15 percent slopes	A	1.4	2.5%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	C	7.3	12.8%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	0.0	0.0%
422B	Canton fine sandy loam, 3 to 8 percent slopes, extremely stony	B	29.3	51.8%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	B	15.7	27.8%
600	Pits, gravel	A	1.9	3.3%
Totals for Area of Interest			56.5	100.0%



Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

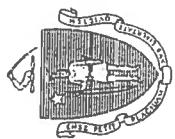
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower







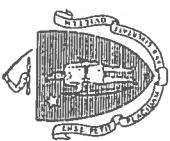
**Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability /**

C. On-Site Review (continued)

Deep Observation Hole Number:

10#1

Additional Notes:



**Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability /**

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#2, Sta. 1+25

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-6	A					S.L.				
6-24	B					S.L.				
24-36	C1					S.L.				
36-96	C2					S.L.				

Additional Notes:



**Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability /**

C. On-Site Review (continued)

Deen Observation Hole Number:

lot#3. 2+90

Additional Notes:



Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#4, LOT44 - 40'
ROAD B

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)		Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color					
0-6	A				S.L.				
6-24	B				S.L.				
24-80	C		60"		S.L.				

Additional Notes:

**Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal**



C. On-Site Review (continued)

Deep Observation Hole Number:

Lot#5, ROAD B 5+00

Depth (in.)	Soil Horizon/ Layer	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
		Depth	Color	Percent					
0-6	A				S.L.				
6-26	B				S.L.				
26-36	C1				S.L.				
36-92	C2		80"		S.L.				

Additional Notes:



Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability /

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#7 ROAD C

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-4	A					S.L.				
4-22	B					S.L.				
22-96	C		60"			S.L.				

Additional Notes:

**Commonwealth of Massachusetts
City/Town of Grafton
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal**



C. On-Site Review (continued)

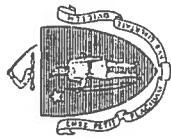
Deep Observation Hole Number:

lot#8, ROAD C 3+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistency (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	A					S.L.					
6-18	B					S.L.					
18-52	C1					S.L.					
52-96	C2		64"			S.L.					

Additional Notes:

**Commonwealth of Massachusetts
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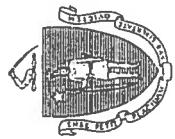
C. On-Site Review (continued)

Deep Observation Hole Number:

Lot#9, ROAD C 5+00

Depth (in.)	Soil Horizon/Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
		Depth	Color	Percent					
0-6	A				S.I.				
6-18	B				S.I.				
18-52	C1		48"		S.I.				
52-96	C2				S.I.				

Additional Notes:



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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#10 ROAD C 8+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-4	A					S.L.				
4-20	B					S.L.				
20-144	C		60"			S.L.				

Additional Notes:



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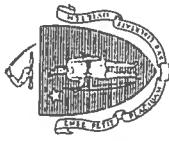
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#6 RDB & RDC

Additional Notes:



Commonwealth of Massachusetts City/Town of Grafton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

lot#11, ROAD B 10+00

Additional Notes:



Commonwealth of Massachusetts
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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#12 ROAD B 12+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-6	A					S.L.				
6-20	B					S.L.				
20-112	C		88"			S.L.				

Additional Notes:

**Commonwealth of Massachusetts
City/Town of Grafton
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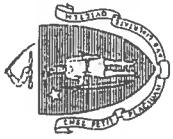
C. On-Site Review (continued)

Deep Observation Hole Number:

Lot#13, ROAD B 14+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-5	A					S.L.					
5-26	B					S.L.					
26-112	C		84"			L.S.					

Additional Notes:



Commonwealth of Massachusetts
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C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#14 ROAD A 8+00

Additional Notes:

Commonwealth of Massachusetts
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C. On-Site Review (continued)

Deep Observation Hole Number:

Lot#15, ROAD A 6+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Cobbles & Stones	Gravel	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent							
0-9	A					S.L.						
9-29	B					S.L.						
29-120	C		102"			L.S.						

Additional Notes:



**Commonwealth of Massachusetts
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Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#16 ROAD A 4+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-6	A					S.L.				
6-30	B					S.L.				
30-144	C		102"			L.S.				

Additional Notes:

Commonwealth of Massachusetts
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C. On-Site Review (continued)

Deep Observation Hole Number:

Lot#17, ROAD A 2+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure (Gravel Cobbles & Stones)	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	A					S.L.					
9-30	B					S.L.					
30-108	C		96"			L.S.					

Additional Notes:



**Commonwealth of Massachusetts
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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

DTH#18 ROAD A 1+00

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (ISDA)	Coarse Fragments % by Volume	Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent					
0-5	A					S.L.				
5-30	B					S.L.				
30-144	C		100"			L.S.				

Additional Notes: